

GULLET LINED WITH GASTRIC MUCOSA
A RADIOLOGICAL STUDY

by

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H I S T O R Y

Twenty years ago hiatus hernia was almost unknown. Since then the literature on the subject has become vast but in spite of this some aspects remain obscure. Sporadic reports extending as far back as the sixteenth century describe mainly traumatic hernias and congenital hernias of the non-hiatal variety.

The first description of a "short" oesophagus type of hiatus hernia was by Bright (1836). The condition was not diagnosed in life till Soresi (1919) developed the head down technique in conjunction with the standard barium examination of the stomach. The first serious study of the subject was by Akerlund (1926) who observed that there were several varieties of the condition. Attention was drawn to their true clinical significance by Guthrie and Jones (1940). The relationship between hiatus hernia, gastro-oesophageal reflux, oesophagitis and stricture was clearly shown by Allison (1948).

In 1950 Barrett made the clear distinction between ulcers of squamous mucosa, which are never much more than shallow erosions, and deep penetrating ulcers which are always in gastric mucosa. This gastric mucosa he clearly showed was not in the form of islets but in a continuous sheet from the stomach below the diaphragm up to the penetrating ulcer or further. His conclusion at that time was that these deep penetrating ulcers were in gastric mucosa lining the wall of a hiatus hernia and not in gullet as was formerly believed. Allison had already pointed out

in 1948 that peptic oesophagitis occasionally occurred in the absence of hiatus hernia and reflux, and he thought that this was due to heterotopic gastric mucosa. In 1953 along with Johnstone he further elaborated this point and showed that what Barrett thought was gastric mucosa lining a hiatus hernia was in fact gastric mucosa lining the oesophagus. This gastric mucosa was not in the form of ectopic islets but in a continuous sheet surrounding the lumen and in direct continuity with the epithelium of the stomach below the diaphragm. Barrett continued to argue that it was more proper to call the tube lined with gastric mucosa, stomach, until comparatively recently, when he finally acknowledged that it was gullet. Although the deep penetrating ulcer of gullet lined with gastric mucosa now bears the name of Barrett, the condition itself should properly be associated with Allison.

CLASSIFICATION

Akerlund described three types:-

I	Congenital short oesophagus with partial thoracic stomach.
II	Para-oesophageal hiatus hernia
III	Oesophago - gastric (A mixture of the previous two)

Harrington (1948) described three types:-

I	Para-oesophageal hiatus hernia.
II	Sliding type.
III	True short oesophagus with hiatus hernia

The distinction between types II and III being the inability

to lengthen the gullet at operation, though he does mention that the gullet may be fixed in a high position by fibrosis. Allison (1951) has three types:-

I	Sliding
II	Rolling type
III	Rolling type with slide

Associated with type I is a small empty peritoneal sac and free gastro-oesophageal reflux. Associated with type II is a large preformed peritoneal sac in the mediastinum and there is no reflux. Type III is a combination of the other two.

Vincent Edmonds attempted another classification of three types:-

I	Sliding
II	Rolling
III	Combined

If efforts to include aetiology into these classifications had been resisted, then all these classifications would have been almost identical. Considering the types purely anatomically they are as follows:-

TYPE I) Sliding Type:-

The oesophagus is apparently short and the oesophago-gastric junction is well above the hiatus entering the stomach at or near the upper limit of a gastric pouch consisting mostly of the cardiac part of the stomach. The general appearance is that of a bell. The gastric

herniation has a small empty peritoneal diverticulum in relation to its anterior and lateral surfaces. Free gastro-oesophageal reflux is nearly always present.

TYPE II) Para-oesophageal:-

The oesophago-gastric junction is below the diaphragm. A varying amount of the stomach is herniated alongside the gullet with a degree of volvulus producing in the extreme a completely inverted stomach entirely in the chest. The hernia is into a large pre-formed peritoneal sac in the mediastinum.

TYPE III)

Type III is as Type II excepting that the gastro-oesophageal junction is slightly above the hiatus.

There have been descriptions of sacless "herniations" by Akerlund (1926) and Harrington (1948) but no definite conclusions were drawn from this and they were not separately dealt with in their classifications.

INCIDENCE

Reported frequencies of the occurrence of hiatus hernias in routine barium meal examinations have been variously reported from about 1% to 12%. The variation depending on the effectiveness and vigour of the techniques used to produce reflux. So vigorous indeed are some techniques directed at increasing the intra-abdominal pressure that one would almost be tempted to include these methods in the aetiology of the condition. Johnstone (1951) quoting a personal communication from C. Pickard gives a figure of 11%. The technique used in many of the

cases here included is that of Pickard. The patient, - after his stomach has been filled with barium, is put in the supine position with a slightly Trendelenberg tilt and is then rolled into the left anterior oblique position. Pressure is put on the abdomen with the hand. The patient is then asked to take several deep breaths and give several coughs. This technique is sufficient to demonstrate most hernias but certainly not all and it is possible to demonstrate a hernia on one occasion but not on another. Reflux is however usually elicited easily in the presence of reflux oesophagitis. A much higher incidence in women in late pregnancy is usual and Rigler and Eneboe (1935) give it as high as 18%.

Type incidence is given by Vincent Edmonds in a series of 200 cases as -

145 sliding	-	72.5%
35 rolling	-	17.5%
20 combined	-	10%

SEX INCIDENCE:

Women to men	2.8	:	1	sliding
	10	:	1	rolling
	19	:	1	combined

AETIOLOGY

The aetiology of the "short" oesophagus type hiatus hernia has been the subject of some controversy. The view of Akerlund that it was due to a congenitally short oesophagus was widely disseminated but has tended to fall into disrepute. Thoracic surgeons soon became aware that in many of these cases the stomach could easily be returned

to the abdomen and there was no actual shortening of the oesophagus to impede this process, the shortening of the gullet being only apparent and due to the ability of the longitudinal muscle to "take in slack". A small group of cases, however, could not be included in the group of acquired sliding hernias. These cases showed a high mucosal transition and even in the absence of oesophagitis the gastric mucosa could not be brought down below the diaphragm. The name congenital short oesophagus was then applied to this group and indeed still is in some quarters. The observations of Allison over the last ten years show that many of these cases of so-called congenital short oesophagus are in fact gullet lined with gastric mucosa. It is the considered view of some that the term congenital short oesophagus should no longer be used as there is no case to which it may suitably be applied. It is worth commenting here that a case with obvious stomach above the diaphragm without a peritoneal sac might properly be described as congenital short oesophagus with partial thoracic stomach, should such a type exist.

It has been suggested that acquired hernias are preceded by oesophagitis and the resulting fibrosis pulls the stomach into the chest. This opinion is not tenable as hernias without oesophagitis are very frequent and may precede the oesophagitis by many years. The accepted view today is that increased intra-abdominal pressure from any cause e.g. obesity or pregnancy, is the immediate cause of the herniation, though other predisposing causes have been cited.

after his operation but subsequently developed neurological symptoms in spite of B12 replacement therapy. The neurological symptoms responded to Thiamine. Five years after the operation he died and the post-mortem confirmed a diagnosis of hepatic cirrhosis.

COMMENT

The junction of oesophageal and gastric mucosa is shown endoscopically to be at 28 cms. at the level of the left main bronchus. (The site of the stricture shown radiologically) Downwards from there to the hiatus the gullet was lined with gastric mucosa, confirmed by pathological examination of the resected specimen. This segment at operation looked externally as oesophagus and had an oesophageal blood supply. There was no evidence of hiatus hernia at operation or by barium examination and there was no radiological evidence apart from the stricture that the lining of the gullet was other than normal. Gastro-oesophageal reflux was either absent or difficult to produce. The stricture at the mucosal transition was either the result of oesophagitis or due to a healed Barrett's ulcer, most likely the former.

The mechanism by which the cardia of the stomach is normally kept below the diaphragm is considered by Allison (1951). He mentions first, though probably not in order of importance, the phreno-oesophageal ligaments. These represent an extension of the deep fascia on the under surface of the diaphragm through the hiatus to become continuous with the fascia propria of the oesophagus. They consist of fibro-elastic tissue, and allow the pull of the diaphragm on inspiration to be more evenly distributed over the organ rather than being concentrated on the cardia, and he likens them to a parachute harness. Secondly Allison stresses how the right crus of the diaphragm loops round the acute angle of the oesophago-gastric junction anchoring it down to the lumbar spine. Increased intra-abdominal pressure may split the muscle fibres and render the mechanism ineffective.

PERITONEUM Fig. 1.

The peritoneum on the surface of the stomach is reflected on to the under surface of the diaphragm and as it is very closely applied to both these structures its reflection forms something of a ligament. Cunningham and Grays Anatomy textbooks state that the posterior surface of the stomach is covered with peritoneum except for a small somewhat triangular area ($2'' \times 1\frac{1}{2}''$) below and to the left of the cardia and in direct contact with the diaphragm and sometimes the left supra-renal gland. This is the explanation of the fact that the peritoneal sac in the sliding type is only on the antero-lateral surface

of the hernia. The visceral peritoneum is intimately fused with the wall of the stomach and cannot be stripped off. Only the small bare area of the stomach can pass into the chest without taking peritoneum with it. Barrett (1952) stresses the importance of the left gastric artery and its mesentry in fixing the cardiac portion of the stomach below the diaphragm. Laxity of this mesentry would allow the cardia to slide upwards.

The errors of embryonic development which are said to account for gastric mucosa above the diaphragm are dealt with in a special section.

REFLUX

This occurs almost invariably in conjunction with hiatus hernia of the "short" oesophagus type but may occur without herniation. The mechanism by which competence of the cardia is normally maintained is worthy of consideration and numerous conflicting theories have been elaborated.

According to Jackson (1922) the major factor is the pinch-cock action of the diaphragm occluding the lower oesophagus when the intro-abdominal pressure is increased by inspiration. Surgeons have become aware that the diaphragm does not completely occlude the hiatus even on the deepest inspiration. The internal sphincter mechanism at the lower end of the gullet according to Lerche (1950) is important in keeping the gullet closed save when a bolus is passing. Radiologists are however well aware what a feeble mechanism this is when the oesophago-gastric junction is displaced above the hiatus. The cardiac angle

of His (1903) has been considered by many thoracic surgeons as of vital importance and it has been clearly shown that reflux occurs at a very much lower intra-gastric pressure when this angle becomes less acute as the fundus is depressed. Associated with this acute angle is the valve of Gubaroff (von Gubaroff 1886). In a well-illustrated paper Botha (1958) described mucosal folds around the cardia whose presence is dependent on special tone of the muscularis mucosa which acting in conjunction with the internal sphincter presents a powerful bar to reflux. These mucosal folds in the presence of a normal oesophago-gastric angle tend to spread the intra-gastric pressure evenly over the wall. With a hernia, however, there is a funnel produced directing the pressure at the cardiac orifice. All these mechanisms with the exception of the internal sphincter act synergistically to prevent reflux when the cardia is below the diaphragm but their effect is vitiated in the presence of a hiatus hernia. Reflux has been reported in the absence of a hiatus hernia and though most radiologists have experience of such cases they are not common. Reflux in infants is so frequent as to be considered a normal phenomenon if it occurs intermittently. The cause of reflux in the absence of hiatus hernia is a matter for conjecture and no factual information is available. Lack of tone in the internal sphincter, the oesophagus entering the stomach near the top of the fundus and thus increasing the angle between the gullet and stomach and variations in the mucosal folds

at the cardia have all been implicated. Some apparently normal individuals have the ability or trick of rumination and can bring food back up into the mouth at will.

ESOPHAGITIS

The true significance of reflux oesophagitis in producing strictures of the gullet has only been realised in comparatively recent times. Formerly they were described as ideopathic. Mackenzie (1884) describing acute ideopathic inflammation of the gullet giving rise to dysphagia, was in fact referring to reflux oesophagitis. Experimental work on animals has shown that while the squamous mucosa of the gullet is resistant to hydrochloric acid in concentrations normally found in the stomach, a mixture of acid-pepsin sets up a vigorous inflammation leading to superficial ulceration. The acid-pepsin in fact digests the squamous mucosa. Lower oesophagitis in rats was produced by Selye (1938) by occluding the pylorus but not when the cardia was also occluded. Oesophagitis in dogs was produced by Arroyave, Clatworthy and Wangenstein (1950) by implanting gastric mucosa in the oesophagus. The injurious effect of alkaline duodenal juice on oesophageal epithelium is noted by Barrett (1954). The clear association between "short" oesophagus type hiatus hernia and reflux on the one hand, and of reflux oesophagitis and stricture on the other is made by Allison (1948).

Aylwin (1953) was struck by the fact that some patients developed severe stricture formation of the gullet

in a very short time while others having a hiatus hernia for years suffered only the mildest oesophagitis. He carried out a series of investigations and the result of these would indicate that reflux into the gullet at night is from the intra-thoracic pouch of stomach and not from the stomach below the diaphragm. The degree of oesophagitis is dependent on the population of oxyntic and chief cells in the cardia. His observation is a very difficult one for a radiologist to accept as at barium meal examination the barium is seen to pass freely up and down from stomach to hernia and from hernia to oesophagus and it is difficult to see why it should be different when the patient lies down at night.

ENDOSCOPIC APPEARANCES OF REFLUX OESOPHAGITIS

These are described by Barrett (1950-51). At first the mucosa becomes fiery, oedematous and congested and bleeds easily. The mucosal covering may be shed widely or in patches. There is leucoplakia followed by erosion. The erosion which is shallow usually involves the whole circumference of the wall. The appearance it presents is of a yellow grey patch circumscribed by a narrow crimson edge. The ulcer is generally covered by slough which can be swabbed away leaving a bleeding, raw surface. This state of affairs can persist for a long time without involving the deeper layers of the oesophagus though it may be associated with spasm of the circular muscle. These changes can return to normal if reflux is prevented. If it persists then inflammation spreads beyond the submucosa

into the muscle coat, and beyond, producing fibrous stricture and lymphadenitis and the gullet becomes fixed to the surrounding tissues in the mediastinum.

HISTOLOGICAL APPEARANCES

These are described by Peters (1955). Reflux oesophagitis affects only squamous oesophageal mucosa and is most marked at the mucosal junction. Microscopically there are elements of acute and chronic inflammation implying repeated episodes. Each layer of oesophageal wall protects the one external to it so that after a while there is a terraced effect. Shallow ulcers occur and may lead to leucoplakia. After the lesion has destroyed the submucosa it progresses through the muscle coat producing not a penetrating ulcer but a tumourous mass of inflammatory tissue that becomes fixed in the mediastinum by peri-oesophageal adhesions and adenitis.

It will be obvious from these descriptions that the ulcer of peptic oesophagitis of squamous mucosa cannot by its very nature be manifest radiologically by an ulcer niche. It is a shallow erosion of large area surrounding the lumen. Because of the confusion that may arise this lesion will not, in this paper, be described as peptic ulceration of the gullet but simply as peptic oesophagitis.

PENETRATING ULCERS OF THE GULLET

The first report of a deep penetrating ulcer of the oesophagus was by Albers (1839). Tilleston (1906) described an ulcer of the gullet, at its lower end, simulating a chronic gastric ulcer and quoted 44 cases from

the literature occurring above the cardiac sphincter. In his own case the mucosa surrounding the ulcer had been destroyed by autolysis but in some of the cases reported the surrounding mucosa was gastric and was presumed to be ectopic. There are other reports by Chamberlin (1937) and Lyall (1937). The latter's description is of great interest. The ulcer occurred in a tongue-like projection of gastric mucosa as a direct extension from the cardia of the stomach and resembling histologically the mucosa of the cardia. He called it heterotopic.

In 1942 Dick and Hurst noted the association of penetrating ulceration of the gullet and hiatus hernia. Because of post mortem autolysis they failed to note that the mucosa adjacent to the ulcer was gastric and thus drew the erroneous conclusion that the deep ulcer was due to reflux oesophagitis.

HETEROTOPIC MUCOSA

The first description of ectopic gastric mucosa in the gullet was by Schmidt (1805). Schridde (1904) said that islets of gastric mucosa occurred in the post-cricoid region in 70% of all gullets and that percentage would suggest that they were a normal finding. He may of course have been describing the normal cardiac glands which occur at the upper and lower ends of the gullet, the glands having lost their squamous covering.

In 900 cases described by Taylor (1927) six were sufficiently large to be seen with the naked eye. Fifty-seven cases with islets of gastric mucosa are described by

Rector and Connerly (1941) most of which occur at the upper end, but seven occurred lower down. Oxyntic cells may be present but no definite pathology associated with them has ever been described, with the possible exception of one case of adenocarcinoma by Carrie (1950). Generally speaking it would appear that all pathology attributed to this ectopic mucosa occurs at the lower end of the gullet, while nearly all actual descriptions of it place it at the upper end. The answer to this paradox could well lie in the fact that post-mortem autolysis is most marked at the lower end of the gullet and desquamation is frequent.

BARRETT'S ULCER

Barrett (1950) showed a series of cases of penetrating gastric ulcers in the apparent gullet and demonstrated clearly that they occurred in gastric mucosa which was in a continuous sheet totally lining an intra-thoracic tube and in continuity with the gastric mucosa in the stomach below the diaphragm. At that time he concluded that the gastric mucosa which became ulcerated, even when it extended up to the aortic arch, was in the wall of a partial thoracic stomach.

He points out the extraordinary confusion that arose around the term "peptic ulcer of the oesophagus". The endoscopist Chevalier Jackson (1925) reported 88 cases in 4000 endoscopies while the pathologists Stewart and Hartfall (1929) reported only one in ten thousand autopsies. They thought they were seeing the same thing but in fact Jackson was describing the ulcer associated with peptic oesophagitis

and Hartfall the penetrating ulcer of gastric mucosa. Radiologists have not escaped this confusion and have not infrequently described an ulcer niche as a feature of reflux oesophagitis and even Allison (1948) thought that a deep penetrating ulcer was a late feature of peptic oesophagitis.

OESOPHAGUS LINED WITH GASTRIC MUCOSA

In 1948 Allison described 63 cases of peptic oesophagitis and in all but two of these there was an associated hiatus hernia with reflux. In two of this series there was peptic oesophagitis well above the hiatus and he attributed the oesophagitis to heterotopic gastric mucosa in the gullet below the stricture.

In 1953 in conjunction with Johnstone he demonstrated a group of cases in which the barium examination showed three segments in the chest. The upper segment was gullet down to the stricture due to oesophagitis, the lower segment was an obvious hernia of stomach into the chest, and the middle segment had the radiological appearances of oesophagus. It was clearly shown by endoscopy and operation that the middle segment, like the lower segment, was lined with gastric mucosa and externally at operation it looked exactly like oesophagus, having also a blood supply from the thoracic aorta by short segmental branches and no peritoneal sac. Histologically this gastric mucosa had several unusual features:-

- 1) It was cardiac type mucous secreting columnar epithelium without oxyntic cells.

- 2) Under this columnar epithelium were deep oesophageal mucous glands.
- 3) At any point in this gastric mucosa islets of squamous epithelium might be found.

In every respect other than the nature of its lining epithelium this middle segment was identical to oesophagus and even histologically it had some of the features of gullet. They concluded that this was a segment of gullet lined with gastric mucosa. They agree with Barrett's distinction between the ulcer of peptic oesophagitis of squamous mucosa and the deep penetrating ulcer occurring in the thorax and associated with adjacent gastric mucosa. They do not agree, however, that this gastric mucosa is lining stomach and insist that calling it stomach replaces one confusion with another, leading to an impasse in description since in their cases true stomach was also in the mediastinum. This error in nomenclature can lead to serious mistakes in interpretation and to incorrect operative treatment.

They describe seven cases all with an accompanying hernia of true stomach, five of these being of the short oesophagus type and two para-oesophageal with slide. In one of the paraoesophageal hernias there was no reflux but it was present in the other six. Three of the cases had Barrett's Ulcers in the segment of gullet lined with gastric mucosa and one had superficial ulceration of this epithelium. One case had an adenocarcinoma in the gullet lined with gastric mucosa. There is a description of a similar anomalous distribution of gastric mucosa by Bosher

and Taylor (1951) and in their case there was a stricture due to reflux oesophagitis at the mucosal transition placed at the level of the aortic arch and in addition to this there was a small gastric herniation into the mediastinum. Between these two there was radiologically normal gullet, though it was in fact lined with gastric mucosa.

Some interesting radiological points were made by Johnstone and among these was the observation that the radiographic appearance of the mucosa may give no assistance in localising the transition, and in one case the segment of gullet lined with gastric mucosa showed well marked tertiary wave formation.

FREQUENCY

In 115 cases of oesophagitis and stenosis described by Allison and Johnstone there was indisputable evidence of a segment of oesophagus lined with gastric mucosa between the stricture and the hernia, in eleven cases.

In 1954 Barrett notes that the tube lined with gastric mucosa has an oesophageal blood supply but insists that it is more accurately described as stomach for the following reasons:-

- 1) The absence of a peritoneal covering does not mean that it is not stomach bearing in mind the bare area of the stomach.
- 2) The musculature is indistinguishable histologically from that of stomach. (One might comment here that it may therefore be either oesophagus or stomach. Radiologically it behaves as oesophageal musculature).

- 3) It functions as stomach in that it has a mucous secreting epithelium. (Comment: The oesophagus normally secretes mucous and this segment fulfils the normal function of gullet which is to transfer food from pharynx to stomach).
- 4) Gastric Ulcers and adenocarcinomata occur. (Comment: By this argument it would be better to describe a Meckels diverticulum lined with gastric mucosa as stomach).

The final article on this subject to be reviewed here is again by Barrett (1958) and in this article he acknowledges that the segment in question which is lined with gastric mucosa is indeed gullet and he has at last come round to Allison's point of view. This public acknowledgement that he has changed his mind is a measure of the man and also a measure of the strength of Allison's argument. He does, however, object to the name "Oesophagus lined with Gastric Mucosa" because the whole oesophagus is not so lined and because he objects to the assumption that the columnar epithelium lining the gullet is in fact gastric. There is a little hair splitting here. He makes several interesting points:-

- 1) That although most of the columnar epithelium in gullet contains no oxyntic cells some may occur near the lower end.
- 2) Islets of squamous mucosa can occur at any level.

He described two types of case. One, with no abnormality at the cardia and with no reflux, has what appears to be a normal gullet with the cardiac valve in its normal place yet a portion of the gullet is lined with columnar epithelium. The second, is complicated by a typical sliding hernia. In both varieties different

lesions can occur singly or in combination. These are oesophagitis, penetrating(Barrett's) Ulcer, and Adenocarcinoma. The condition per se is symptomless and is only diagnosed when complicated. He mentions two cases with no reflux but with oesophagitis.

ADENOCARCINOMA

Allison and Barrett have both described cases of adenocarcinoma arising from the gastric mucosa lining the gullet. An interesting contribution to this subject is made by Dodge (1960) in an article in "Gut". They describe eleven cases of adenocarcinoma involving gullet. In seven of these cases the tumour appeared to be entirely intra-oesophageal and in six of these the tumour was continuous below with gastric mucosa. In five of these the upper margin of tumour was bounded by squamous mucosa. In the other, the tumour extended to the upper limit of the resection. Another case was complicated by an ordinary hiatus hernia. They maintain that these adenocarcinomata are occurring in gullet lined with gastric mucosa.

EMBRYOLOGY

In view of the possibility that certain conditions associated with gastric mucosa in the chest are congenital in origin it is worth considering the early embryonic development of oesophagus and stomach and the diaphragm. This subject is reviewed by Barrett (1958) and Peters (1958).

In the fourth week (2-3mm embryo) a fusiform dilatation of the entodermal foregut develops in the cervical region which is the primitive stomach and is separated from the

future pharynx by a constriction known as the oesophageal anlage. During the sixth week the primitive stomach has already a blood supply from the coeliac axis and from then on the growth and development of the oesophagus is rapid. The entodermal oesophageal tube elongates. (Hamilton, Boyd and Mossman - 1952)

The superficial cardiac glands of the oesophagus begin to develop at four months or earlier but the deep glands not until much later probably after birth.

As a component of the mediastinum the oesophagus never acquires a typical mesentery or serosal tunic (Arey 1934). The entodermal epithelium of the oesophagus is composed of small columnar cells ciliated at one stage which are later replaced by cells of squamous type. Johns (1952) states that this process of change from columnar to squamous starts in the middle of the gullet and works out to either end.

During the stage of rapid caudal migration the stomach starts to differentiate from a simple fusiform swelling into a structure with defined curvatures. At the same time the septum transversum descends rapidly and rotates so that it lies nearly horizontally, thus separating the ventral parts of the developing thoracic and abdominal cavities. The pleuro-peritoneal ridges descend with the septum transversum, and both for a short time outstrip, so to speak, the elongation of the oesophagus, so that the stomach is temporarily cranial to the developing diaphragm. During the seventh week (11-18mm) the continued elongation

of the oesophagus is such that the stomach rapidly overtakes and passes the septum transversum and comes to lie in the future abdominal cavity, and during the eighth week the diaphragm is completed round the lower end of the oesophagus. If the elongation of the oesophagus is prematurely arrested, part of the stomach remains in the thorax, and the diaphragm forms around it. This is the embryological explanation of "Congenital Short Oesophagus". An explanation for the "Oesophagus lined with Columnar Epithelium" is provided by a failure of replacement of the original columnar lining of the gullet by squamous epithelium. Harrington (1940) pointed out that if the descent of the stomach was temporarily held up and the diaphragm developed around it though it subsequently descended into the abdomen then that would account for the wide hiatus in some cases of hiatus hernia.

Paracesophageal Hernias are considered to be congenital in origin due to the persistence of the pneumatoenteric recess. Its development is described by Hamilton, Boyd and Mossman (1952). At about the 4mm. stage small pocket-like excavations appear on each side of the dorsal mesogastrium. These are the right and left pneumatoenteric recesses. The left one is transitory but the right one extends progressively into the mesentery. It extends cranially on the right side of the oesophagus. Essentially this recess forms a large irregular space with a narrow opening into the peritoneal sac. The persistence of this recess results in a fixed peritoneal sac in the

mediastinum into which stomach at any time may herniate surrounded by its visceral peritoneum.

Finally there are some points of anatomy, physiology and histology which are relevant to the understanding of observations made elsewhere in this paper.

BLOOD SUPPLY OF THE GULLET AND ADJACENT STOMACH

This has been described in detail by Demel (1924).

Above the aortic arch the oesophagus is supplied from branches of the thyro-cervical trunk. Below the arch the oesophagus is supplied by 4 or 5 oesophageal arteries, in segmental pairs, and arising directly from the thoracic aorta. In addition small branches are received from the bronchial and intercostal arteries. The segment of the oesophagus in relation to the hiatus is supplied from the coeliac axis mainly by the left gastric artery and also the cardiac portion of the stomach. Fig.1.

PHYSIOLOGY

There have been various reports of an anatomical sphincter at the lower end of the gullet (Hurst and Rake - 1930). There have been at least as many denying the existence of such an anatomical sphincter (Beattie - 1931 and Lendrum - 1937). In view of the difficulty of a large number of investigators to demonstrate an anatomical sphincter it is widely assumed that there is little if any anatomical sphincter present at the lower end of the gullet. In spite of any strong evidence of an anatomical sphincter, radiologists are daily aware of the fact that there is normally intermittent delay in the passage of barium from

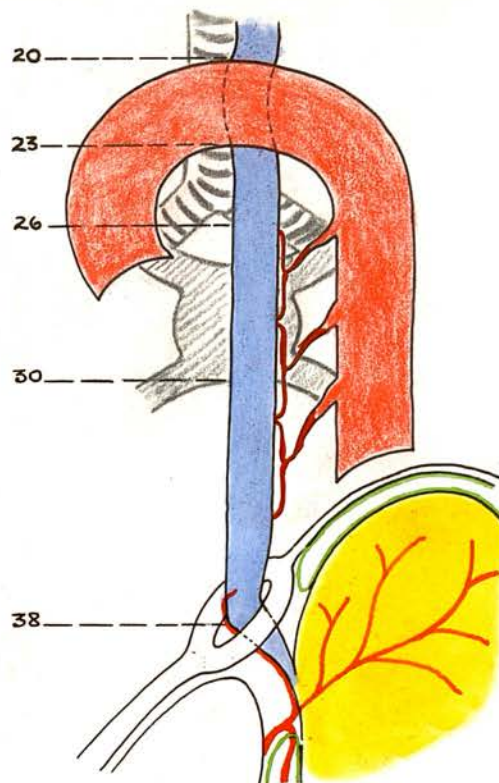


Fig.1

Diagram of the anatomical relationships of gullet and adjacent stomach with the oesophagoscopic levels indicated.

- GASTRIC MUCOSA
- SQUAMOUS EPITHELIUM
- BLOOD VESSELS
- PERITONEUM
- DOUBTFUL PERITONEAL SAC
- ULCER AND/OR STRICTURE

Key to all the coloured diagrams including Table 6.

gullet to stomach at or about the level of the hiatus and that this is not due to the "pinch-cock" action of the diaphragm is apparent in the presence of a hiatus hernia. Just at the junction of the gullet with the hernia there is a temporary hold up of barium and when this has been overcome there is an area of intermittent contraction and narrowing at the same site. The fact that it is intermittent rules out the possibility that it is due to the attachments of the phreno-oesophageal ligaments or oesophagitis.

It is possible at operation by inserting the finger into the lower reaches of the gullet to feel it gripped by a sphincter-like mechanism (Botha - 1958), and further objective confirmation of these observations is supplied by the techniques of intra-luminal oesophageal pressure recordings. A high pressure zone was established by Fyke, Code and Schlegel (1956) similar to that encountered at the pharyngo-oesophageal junction and it extended from 1 to 2cms. above the hiatus to 1 to 2cms. below the hiatus and these findings are confirmed by Hightower (1959). It would appear that there is a physiological sphincter mechanism and it is normally closed unless compelled to open in advance of a peristaltic wave descending the gullet. Any doubt as to whether this high pressure zone is due to an external mechanism like the diaphragm is removed by the fact that this high pressure zone is still present but at a higher level when associated with hiatus hernia. This has been shown by Carre and Astley (1958),

in this country, and by Texter, Lazer, Pulette and Vantrappen (1959) and Vantrappen, Texter, Barborka and Vandenbroucke (1960) in the United States.

HISTOLOGY

Normally the oesophagus is lined throughout by stratified squamous epithelium. It contains two types of glands:-

1) Superficial cardiac glands. These occur between the cricoid and the 5th tracheal ring and in the last few mm. of gullet although superficial they have a covering of squamous epithelium and do not contain parietal cells and can thus be distinguished from heterotopic mucosa - (Rios Solans - 1953).

2) Deep oesophageal mucous glands. They are distributed sparsely and unevenly throughout the oesophagus, are 200-300 in number and lie in or below the muscularis mucosa. They have a much later embryonic development than the superficial cardiac glands sometimes not appearing until after birth - Dabrowski (1894).

NOMENCLATURE

Several terms used with reference to the gullet, both anatomical, physiological, and pathological have lead to more confusion than clarity. The first is the term "oesophagus" itself. What is meant by the term? It may be defined as that part of the alimentary tract, beginning at the crico-pharyngeal sphincter and ending in the stomach below the diaphragm, which is lined with squamous mucosa. This would be easily acceptable were it not for the fact

that cases occur where from below upwards a large portion of this "oesophagus" may be lined with gastric mucosa and in direct continuity with the mucosa of the stomach.

Barrett (1958) prefers the term "gullet" which is defined in the Oxford English Dictionary as "the passage by which food and drink pass from mouth to stomach". This term is helpfully non-committal and will be used in this paper.

The condition of "Gullet lined with Gastric Mucosa" is not generally accepted as such in the Thoracic Surgical Unit in Edinburgh nor in the Ancillary Services associated with it and the term "Congenital Short Oesophagus" is more widely accepted and certain terms associated with this concept will appear in operative and pathological reports. A good example of this is that any part of the alimentary tract in the chest lined with gastric mucosa may be referred to as "stomach" whether or not all other observations would indicate that it is oesophagus. These other observations will be brought out in the text.

The term "cardia" may refer to at least three things:-

- 1) The point where the gullet enters the stomach.
- 2) The point where the mucosa changes from columnar to squamous epithelium.
- 3) The point where the complicated valve mechanism lies, which prevents reflux.

In some of the cases appearing in this paper the mucosal transition may be above the aortic arch, the internal sphincter of the gullet at the level of the inferior pulmonary vein and no mechanism to prevent reflux exists at all. To avoid any possible confusion the term "cardia" by itself will be avoided though the term will

appear in the extracts of the operation notes and usually means the mucosal transition. The cardiac portion of the stomach is that part adjacent to the oesophageal opening and need not give rise to confusion.

The term "peptic ulcer of the oesophagus" has been dealt with in a previous section. Shallow ulceration of squamous mucosa due to the action of acid-pepsin will be called "oesophagitis". The deep penetrating ulcer of gullet lined with gastric mucosa will be called a Barrett's Ulcer.

MATERIAL AND METHOD

One hundred cases classified in the card index as short oesophagus type hiatus hernia and operated upon were studied and the radiological features correlated with the oesophagoscopic and operative findings. The cases were classified into groups based on the anatomical findings at operation and the frequency of the various types established.

Results:- Four types of abnormality could be detected.

TYPE 1

In this there was a hernia of a portion of the stomach, the cardiac portion for the most part, with apparent shortening of the oesophagus. The hernia was supplied from the left gastric artery with the addition of an empty peritoneal sac mainly on its anterior and lateral surfaces. The gullet above is normally lined with squamous mucosa and is supplied by short arterial twigs from the aorta. The features of this group were all well defined.

TYPE 2

In this group the degree of bulging of the hernia above the hiatus was more variable but the situation was generally similar to the foregoing with the difference that a peritoneal sac was absent and the peritoneum so firmly fixed below the diaphragm without redundancy that it was impossible to imagine that it had been at any time above the diaphragm. This group was not so well defined as the former and certainly a few cases in this group could conceivably represent self-reducing hernias and also a small number could conceivably be placed in the group following.

TYPE 3

In this group the oesophagus looked entirely normal right down to the hiatus and there was no external evidence of stomach in the chest. The blood supply was entirely by short twigs from the aorta. Internally the lower portion of the gullet is lined with gastric mucosa sometimes extending as far up as the aortic arch.

TYPE 4

This was a combination of type 1 and type 3. There was a hiatus hernia producing an obvious gastric dome supplied by the left gastric artery and having a peritoneal sac in relation to it. The oesophagus above it although having no peritoneal sac and looking externally normal with a normal oesophageal blood supply is lined for a variable length from the oesophago-gastric junction upwards by gastric mucosa.

TABLE 1Number of cases - 100

Types	1	(1 or 2)	2	3	4
	27	39	20	5	9

The 39% in group 1 or 2 were cases in which the description of the operative findings did not make it possible to be sure whether a peritoneal sac was present or not. It is not thought that this table gives any indication of the distribution of these types in relation to hiatus hernia generally as these were all specially selected as cases suitable for operation.

OE SOPHAGOSCOPIC LEVELS Fig.1

In anatomy text-books the distance from the upper alveolus to various levels in the oesophagus are easily measured and these measurements are remarkably independent of stature and body build. Cunninghams Anatomy states that the upper end of the oesophagus is at 15cms. the left main bronchus at 22.5cm. and the hiatus at 35cm. During the review of the hundred cases previously mentioned, oesophagoscopic levels were compared with radiological levels and with levels determined at operation. The distances were always much greater than those estimated by anatomists and this can easily be explained by the fact that the oesophagoscope tends to stretch the gullet as it is passed down thus it will always tend to exaggerate the distance of a structure or an ulcer from the upper alveolus though it will never make the distance less than it actually is.

Observations on a large number of cases where the level of a stricture has been assessed oesophagoscopically, radiologically and at operation would indicate that the upper border of the aortic arch is assessed endoscopically at 20cm.+. The lower border of the aortic arch at 23cm.+. The left main bronchus at 26cms.+ and the Inferior pulmonary vein at 30cm.+. The hiatus is usually at 38cms.+. The Inferior pulmonary vein lies about half-way between the carina and the diaphragm on an ordinary chest radiograph, this being assessed by studying various angio-cardiograms. The importance of this point is that the inferior pulmonary vein is a landmark to the thoracic surgeon. (See Fig.1)

ADENOCARCINOMA

The occurrence of an adenocarcinoma involving a portion of gullet lined with gastric mucosa has already been described by Barrett. All the cases of adenocarcinoma of the gullet seen at endoscopy were reviewed. These numbered 176, the endoscopic level varying from the level of the hiatus to the aortic arch.

TABLE 2

Endoscopic Levels of 176 cases of Adenocarcinomata

Endoscopic Level	40cm. +	35cm. +	30cm. +	22cm. +
No. of cases	66 cases	56 cases	37 cases	17 cases
Percentage	37.5%	32%	20.5%	10%
Associated Hernias	2 para-oesophageal hernias	No hernias	2 Hernias "short" oesophagus type	7 Hernias "short" oesophagus type

No case of adenocarcinoma had squamous mucosa below it and all were continuous with gastric mucosa inferiorly. (B.T. le Roux, personal communication. Thorax, In Press). Eleven cases were complicated by hiatus hernia either of the short oesophagus type or para-oesophageal variety. In view of the fact that adenocarcinoma can grow up the gullet obscuring the anatomical features, in most cases, it was not possible to say in retrospect whether the adenocarcinoma had occurred in a segment of gullet lined with gastric mucosa or whether it had grown up from gastric mucosa in a hiatus hernia or from a normally placed cardia. In two cases however the gastric mucosa was seen to extend upwards beyond the carcinoma, to the aortic arch in one case and to the left main bronchus in another. These two cases are considered to be adenocarcinoma in a segment of gullet lined with gastric mucosa and one of these cases is illustrated in this series. Our experience is that adenocarcinoma of the gullet always arises from gastric mucosa.

ILLUSTRATIVE CASES

Examples are given of types 1, 2, 3, 4. The cases belonging to types 3 and 4 were made the subject of a special study and cases are included for illustration which have had no operation and also cases which have been operated on since the survey of 100 cases was undertaken. The cases from the series number 14 and the added cases 13.

ILLUSTRATIVE CASEGroup 1

Overleaf are the illustrations of a typical case belonging to Group 1 consisting of a radiograph of the barium examination of the patient's gullet (Fig.2) and a coloured diagram showing the distribution of the squamous and gastric epithelium, the blood supply and the peritoneal relationships. (Fig.3) The key to the coloured diagram is shown on page 23.

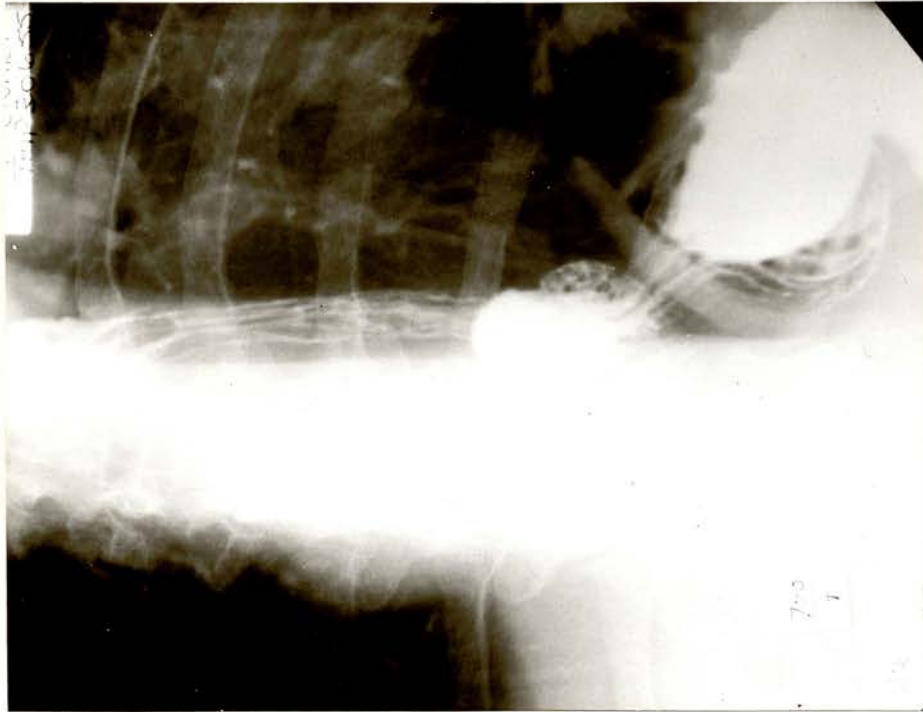


FIG. 2

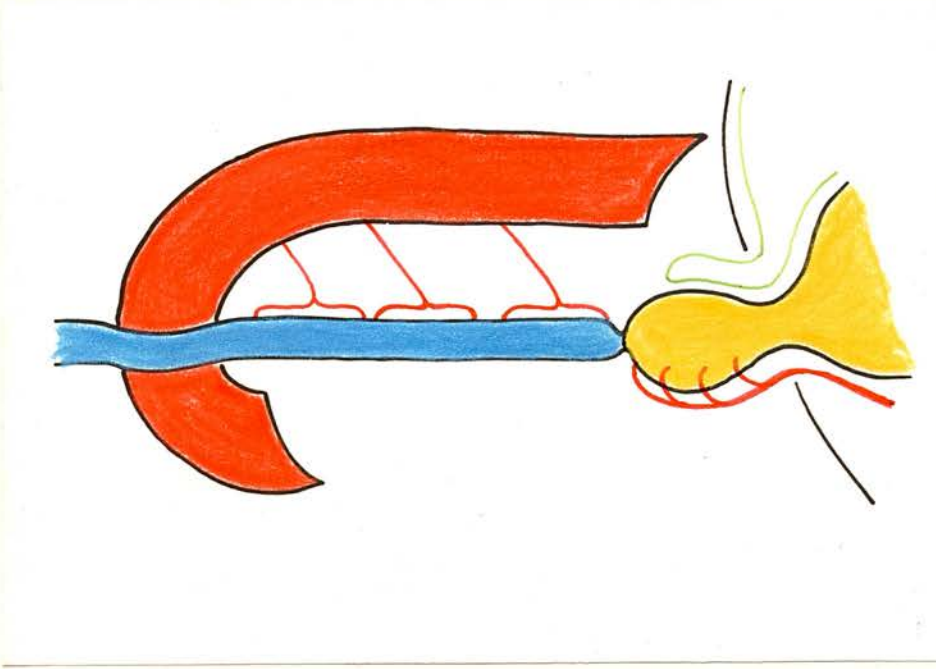


FIG. 3

ILLUSTRATIVE CASEGroup 2

Overleaf are the illustrations of an example of Group 2 consisting of a radiograph (Fig.4) of the barium examination of the patient's gullet and a coloured diagram showing the distribution of the squamous and gastric mucosa, the blood supply and the peritoneal relationships. The key to the coloured diagram is shown on page 23. The fact that the viscus which is lined with gastric mucosa lying immediately below the stricture is in fact stomach is shown in the post-operative radiograph (Fig.6) where most of it is seen to be reduced below the diaphragm and to have become part of stomach and this is despite the fact that there was no peritoneal sac at operation and no evidence of peritoneal redundancy.



FIG. 4

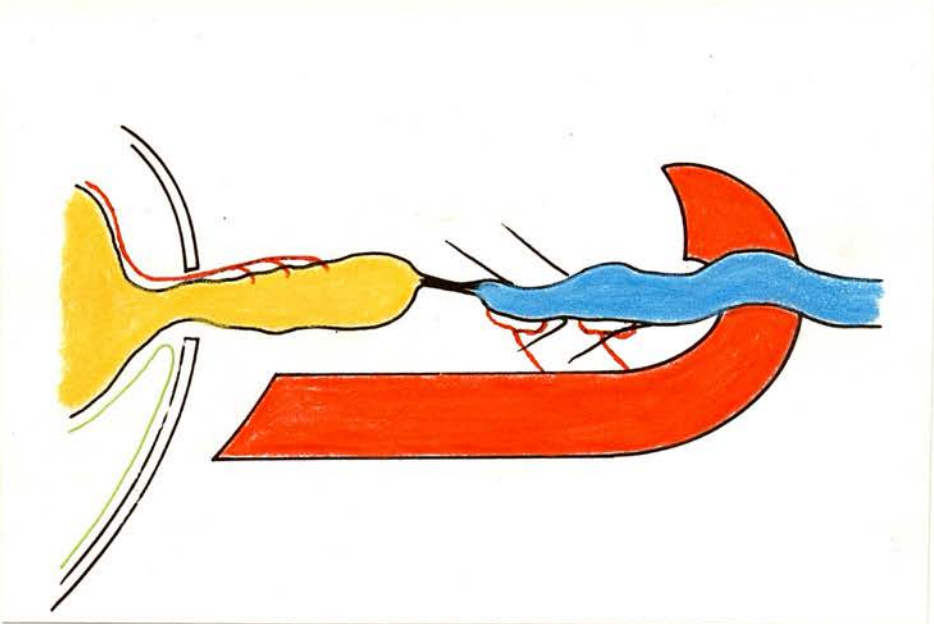


FIG. 5

FIG. 6



GROUPS III and IV

These are represented by the following 27 cases in which evidence is presented to show that they all have a portion of lower gullet lined with gastric mucosa. The observations of the radiologist, the surgeon, and the pathologist at the time will be correlated in order to show how the diagnosis may be arrived at radiologically.

CASE - D.T.

Male aged 19 years

ADMITTED 1952

COMPLAINTS

Regurgitation for eighteen years.

HISTORY

At the age of six months this patient began to bring up his food, this continued until the age of twelve when he began to notice difficulty in swallowing. If he tried to take a normal meal he felt the food stick at cricoid level and this was followed by regurgitation. At times he was only able to swallow liquids. He was treated for oesophageal stricture by an E.N.T. surgeon who dilated the stricture with bougies, this relieved his dysphagia until July 1951 when his symptoms returned.

BARIUM MEAL Fig.7.

Smoother stricture at left main bronchus level. There was no obvious hiatus hernia when supine but there was gastro-oesophageal reflux. The mucosa between the stricture and the hiatus is more rugose than usual and may be gastric.

OE SOPHAGOSCOPY

At 30 cms. from the upper alveolus there was a stricture which firmly held a No.17E bougie. There were associated changes of peptic oesophagitis.

BIOPSY (Just below stricture)

This specimen is small and difficult to orientate. It consists of branching tubular mucous glands and their

stroma. The glands are lined with healthy columnar epithelium.

OPERATION - Extract from operation notes.

Left thoracotomy. Enlarged glands were visible in the pulmonary ligament and in relation to the oesophagus as high as the aortic arch. The oesophagus was exposed through the pulmonary ligament by sharp dissection as high as the crossing of the left main bronchus. The oesophagus at this level was thick but was believed to merely hypertrophic as a result of the stricture below it. It was calculated that the mucosal transition lay two inches above the hiatus oesophageus. The diaphragm was detached from the anterior chest wall to give access to the abdomen. No abnormality was appreciated in the abdomen. The stomach was mobilised. The oesophagus was divided at the crossing of the left main bronchus which was believed to be well above the level of the stricture. It was immediately apparent that the stenosis extended as high as this level and a further one inch of oesophagus was removed. Oesophago-gastrostomy was completed.

DESCRIPTION OF RESECTED SPECIMEN

The specimen of distal one inch of oesophagus and the proximal half of "stomach". Most of the segment of the specimen which from the outside looks like oesophagus is seen after opening to be in fact stomach which forms an intra-thoracic tube. The oesophageal mucosa that is present is ulcerated and the wall of lower oesophagus is thick, fibrous and oedematous. The gastric mucosa is

normal. The line of division of the oesophagus has passed through abnormal tissue.

PROGRESS

Six years after the operation the patient is entirely asymptomatic and radiologically and oesophagoscopically he has normal post-operative appearances.

COMMENT

Endoscopically the transition between oesophageal and gastric mucosa is above left main bronchus level and this is confirmed by biopsy and is the site of the stricture seen radiographically. From the operation report and the description of the resected specimen the tube distal to stricture and lined with gastric mucosa looks externally identical to gullet. Radiologically there was no hernia but there was reflux. The pre-fixed gastric mucosa was radiologically more rugose than squamous epithelium and had some gastric characteristics.

ILLUSTRATIONS

Case D. T.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

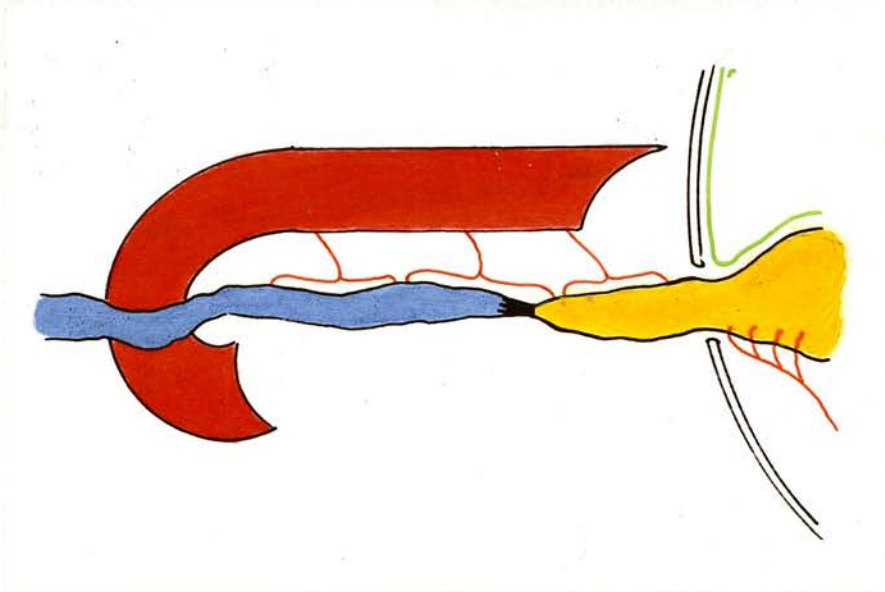
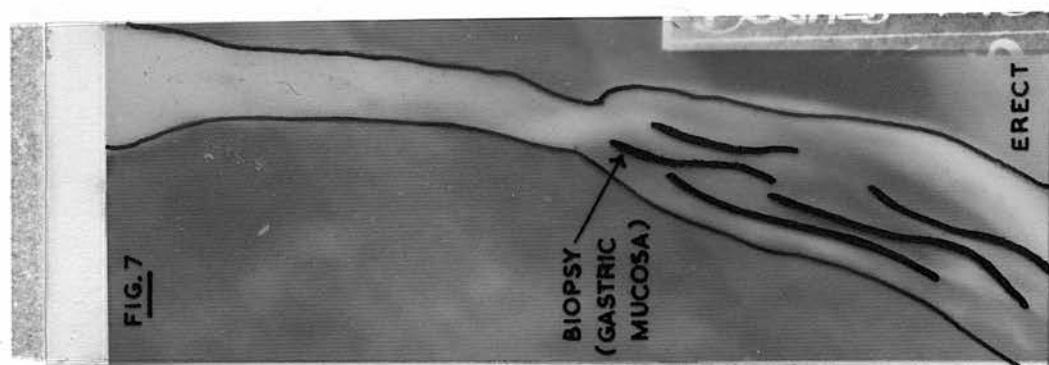
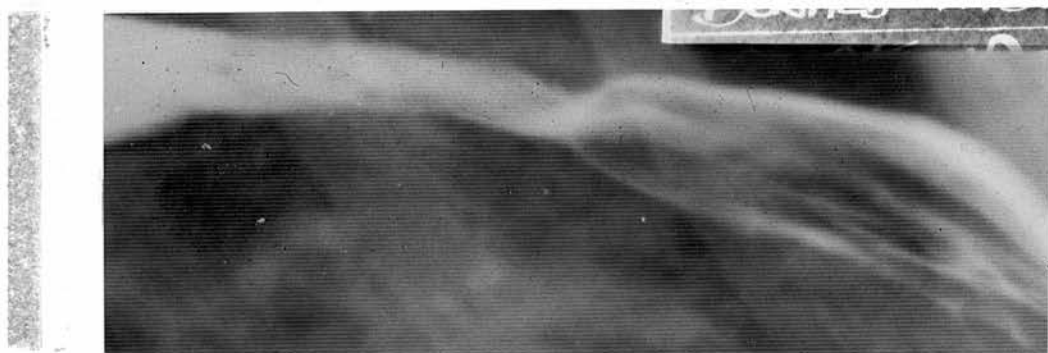


FIG. 8





CASE - M. Cl.

Female aged 43 years.

ADMITTED 1952COMPLAINTS

Backache, vomiting and retrosternal pain for nine months.

HISTORY

The patient's trouble began nine months ago in the fifth month of her last pregnancy with a pain in the middle of the back which was like toothache in nature. It occurred about once a day and sometimes also at night. It was unrelieved by heat and analgesics. She thought it was just one of the afflictions associated with pregnancy although she had not experienced it on previous occasions. During the last three months of the pregnancy she "could not face food". She vomited every day bringing up "phlegm" and undigested food, the vomiting being preceded by pain behind the sternum which would begin very shortly after food. The pain was relieved by the vomiting. The pain in the back and the sickness (which she also attributed to the pregnancy) became more severe as the pregnancy continued. The birth was quite normal and was followed by relief from symptoms but only for a short time. At present she still has backache but it is not so severe as it was though she still feels that "there is something there". She does not think her food sticks but has "occasional spasms" of vomiting. She has to be careful what she eats, for example, she can take milk puddings and scrambled eggs with impunity but fish, meat and ice

cream cause vomiting. She thinks she has lost a little weight. She has had eight previous pregnancies all uncomplicated. She has had no illness and no previous backache or dyspepsia.

BARIUM MEAL Figs. 9 and 10.

Short oesophagus type hiatus hernia with free reflux. Above the hernia apparently in gullet is a large ulcer crater. Stomach and duodenum negative.

OE SOPHAGOSCOPY

At 28cms. from the upper alveolus a normal transition from oesophageal to gastric mucosa became apparent. There was no oesophagitis and no stricture. From below this level there was a constant ooze of blood but its source could not be seen. Tissue was taken from immediately below the transition and sent for histology.

BIOPSY

The specimen consists of normal gastric mucosa.

OPERATION - Extract from operation notes.

Left thoracotomy. The bulge of the hernia was seen in the pulmonary ligament. The oesophagus and herniated stomach were mobilised. The gullet immediately above the hernia was firm and rubbery. Large soft glands were related to it. No abnormality was felt in the stomach. The stomach was divided at the junction of its distal and middle thirds. The pylorus was digitally dilated. The oesophagus was divided where it felt normal behind the left main bronchus and end to end oesophago-gastrostomy was performed.

PROGRESS

Six years after the operation she was entirely well with normal post-operative radiological appearances.

COMMENT

Oesophagoscopically the mucosal transition between oesophageal and gastric mucosa is just below left main bronchus level at 28 cms. and this is proved histologically. At operation the site of ulceration is localised to the gullet immediately above the hernial dome, well below the level of the mucosal transition. The ulcer visible radiologically is in gullet lined with gastric mucosa. This gastric mucosa is in no way apparent radiologically its presence has to be inferred from the fact that all simple oesophageal ulcers visible radiologically are in gastric mucosa.

ILLUSTRATIONS

Case M. Cl.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examination with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

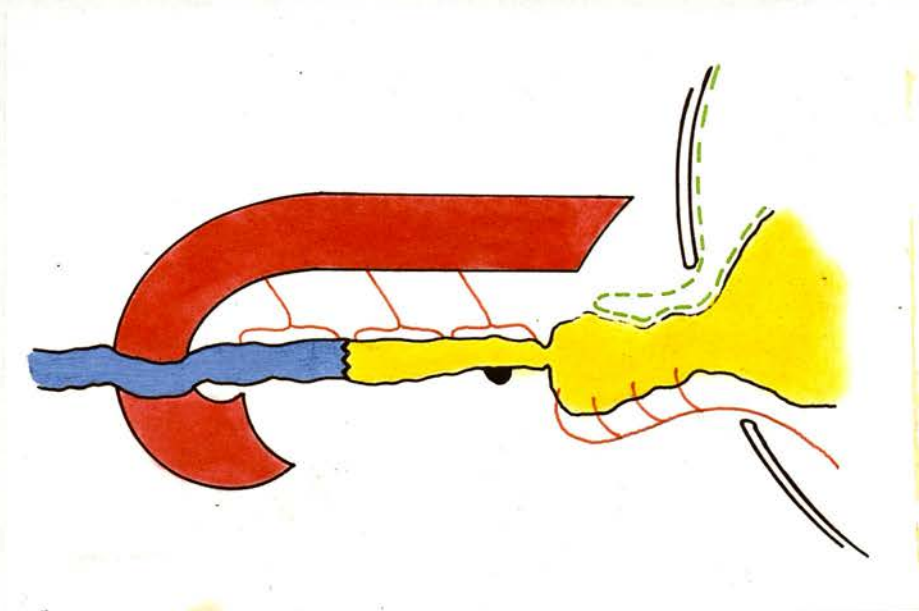
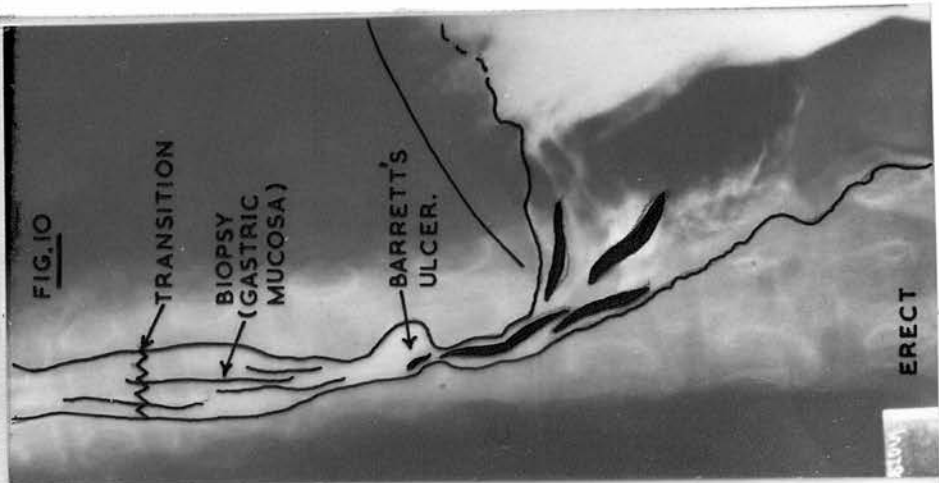
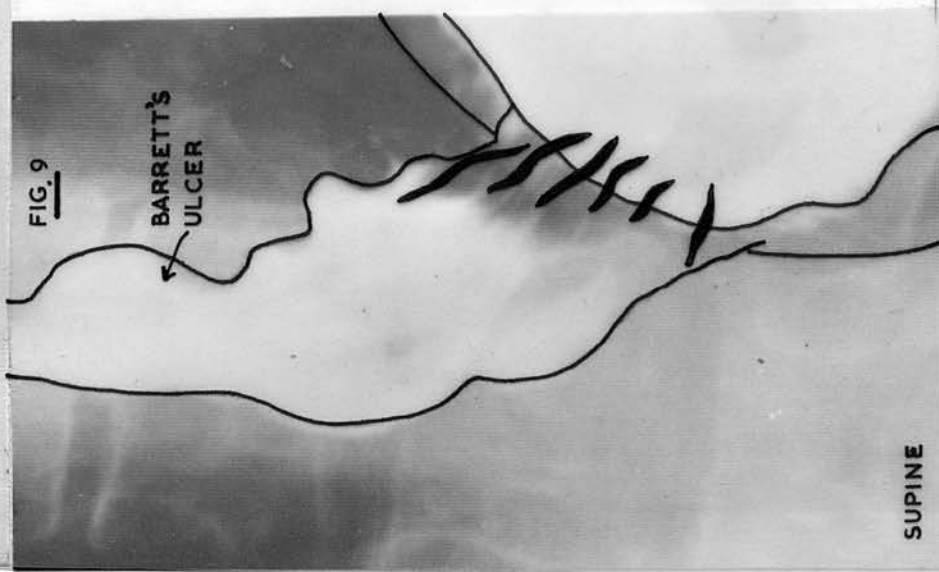
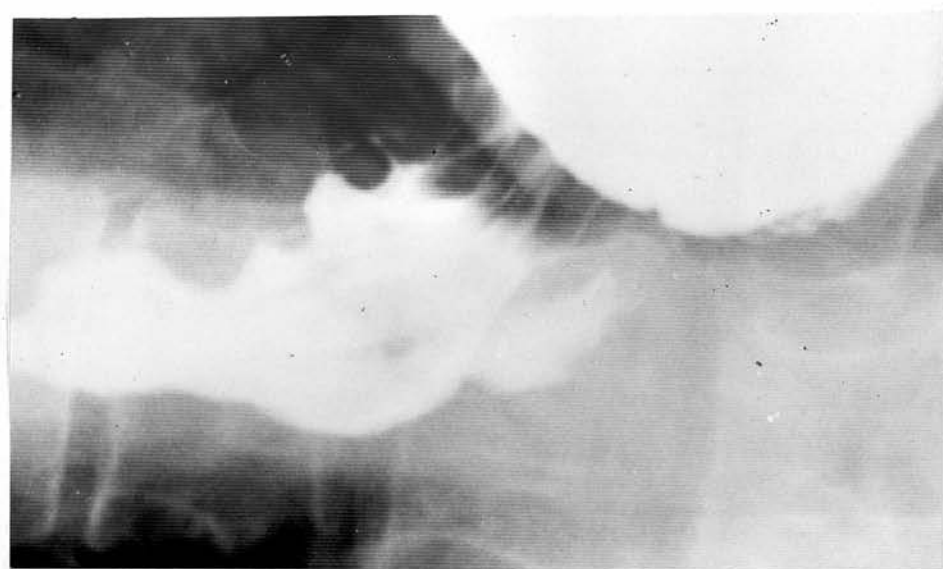


FIG. II





CASE - A.P.

Female aged $3\frac{1}{4}$ years

ADMITTED 1953

HISTORY

The child was normal at birth. Birth weight 8lbs. 2 ozs. She was breast fed until 4 months. She fed well but with some regurgitation and did not gain weight. At four months she had measles and thereafter refused the breast. She was then changed to the bottle and from that date has vomited everything. Vomiting has become progressively worse with solid foods. She always vomits a small quantity during or after each meal but has had attacks of several weeks when everything is vomited. She was first seen in R.H.S.C. in December, 1951 when her weight was 21 lbs. It was considered then that the vomiting might be functional and she was ordered to return in two months for re-assessment but she never returned until the present time. Weight now 14lbs. $10\frac{1}{2}$ ozs.

BARIUM MEAL Fig.12.

The oesophagus is narrowed from the carina downwards, smoothly and uniformly. It appears to dilate to more normal calibre just above the diaphragm. There is no evidence of a hiatus hernia. Appearances suggest congenital atresia.

OESOPHAGOSCOPY

The oesophagus was dilated and filled with frothy liquid. Mucosa was normal everywhere until about 18cms. from the upper alveolus. The lumen narrowed to a pin-point

through which a bougie, size 11F, passed with ease but a number 15F was held firmly. The stricture was dilated to size 18F. Regurgitation of gastric contents occurred throughout and there was a little bleeding initially.

SECOND OESOPHAGOSCOPY

The stricture was reached at 18 cms. and was dilated to 24F. There was no superficial oesophagitis.

OPERATION - Extract from operation notes

Standard left thoracotomy. Densely adherent "stomach" was exposed. This dense fixation extended from the hiatus oesophageus to the lower border of the aortic arch. The upper limit of the stricture appeared to be less than 1" below the aortic arch and the hard, sausage-like mass extended downwards for 2". The oesophagus and the thoracic "stomach" were mobilised. The mobilisation had to be done by sharp dissection. There was no demonstrable peritoneal diverticulum in the mediastinum. The subphrenic part of the stomach was normal. The oesophagus was drawn downwards at the aortic arch and divided at a level naturally lying above its lower border. End to end oesophago-gastrostomy was performed.

DESCRIPTION OF RESECTED SPECIMEN

The specimen consists of distal oesophagus and proximal "stomach". No diaphragm is recognisable. At the junction of oesophagus and "stomach" the lumen is reduced to a diameter of approximately 3 mms. and the wall of the oesophagus at this level is thickened and rigid. The mucosa at the level of the stricture is superficially

ulcerated. The oesophagus proximal to the stricture and the "stomach" beyond it appears normal.

PROGRESS

Several years after the operation is eating all foods without difficulty and is active in every way. She is, however, rather small and underweight for her age.

COMMENT

The transition between oesophageal and gastric mucosa is shown endoscopically and by description of the resected specimen to be at the lower border of the aortic arch. This is the site of the radiological stricture. In spite of the fact that there is no description of the blood supply it is presumed that the tube distal to stricture and lined with gastric mucosa is in fact gullet since there was no radiological evidence of hiatus hernia. There is no obvious explanation for free reflux of gastric contents described.

ILLUSTRATIONS

Case A. P.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and operative findings. The key to the coloured diagram is shown on page 25

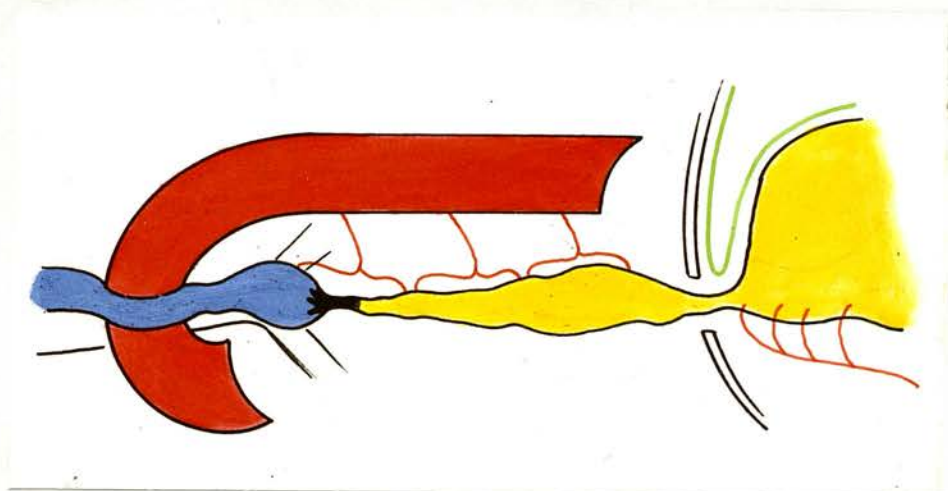
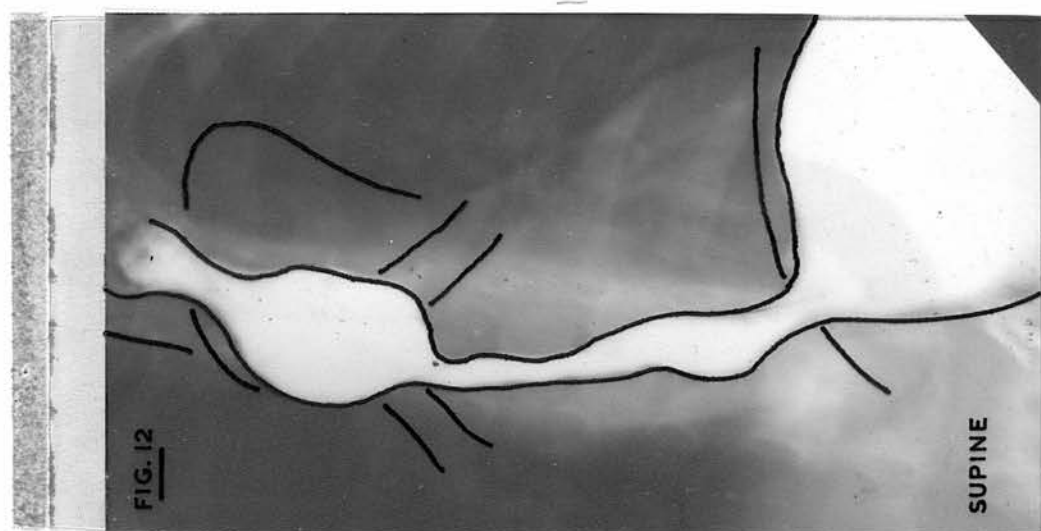


FIG. 13





CASE - A.Y.

Male aged 53

ADMITTED 1954

COMPLAINT

Haematemesis five weeks prior to admission.

HISTORY

Six weeks ago he sustained a back injury which was diagnosed as a "slipped disc". He was confined to bed to lie flat on boards. He normally sat up at night as he was advised to do in another hospital where a diagnosis of short oesophagus type hiatus hernia with reflux oesophagitis had been made three years previously. One night five weeks ago while lying flat on his back he experienced severe retro-sternal discomfort and rapidly became collapsed. He was diagnosed as coronary thrombosis and was admitted to hospital where he vomited half a pint of dark blood not mixed with food. He has vomited again on two subsequent occasions. Since admission with diet and alkalis his symptoms subsided. He was finally referred to the Thoracic Unit.

BARIUM MEAL Figs.14 and 15.

Moderate sized hiatus hernia of the short oesophagus type with regurgitation. There is an ulcer crater present lying above the estimated position of the cardiac orifice. Rest of stomach and duodenum negative.

OESOPHAGOSCOPY

At 27 cms. there was a normal transition from oesophageal to gastric mucosa. At 34 cms. there was an

ulcer, with a white base, one cm. in diameter. It had a clean cut edge and appeared to be situated posteriorly in gastric mucosa. Tissue was taken - 1) From the edge of the ulcer 2) From the mucosa at the level of the ulcer 3) From the mucosa proximal to the ulcer. The three specimens show mucosa of the type found in the cardia of the stomach.

OPERATION

Standard left thoracotomy. There was no obvious gastric dome in the pulmonary ligament. The hiatus admitted five fingers. On closer examination it was apparent that there was an inflammatory lesion in relation to distal oesophagus and it was judged that an ulcer was penetrating the pulmonary ligament. The oesophagus was mobilised and was found to be large and thick walled and a site for section was chosen at the crossing of the left main bronchus. The stomach was divided and an end to end oesophago-gastrostomy was performed.

HISTOLOGICAL REPORT ON ULCER

The changes are those of a chronic gastric ulcer.

PROGRESS

In 1956 he was well and quite asymptomatic and has not been seen thereafter.

COMMENT

The transition from oesophageal to gastric mucosa was shown at endoscopy to be at 27 cms. (the level of the left main bronchus) and this was confirmed by biopsy. There was no radiological evidence of any change at this

level. The presence of a segment of oesophagus lined with gastric mucosa can be inferred from the ulcer niche above the apparent junction of oesophagus with stomach since the changes of reflux oesophagitis of squamous mucosa do not manifest themselves in this way. The hiatus hernia was not obvious at operation and a self reducing hernia is inferred from the size of the hiatus which admitted five fingers. The ulcer niche represents a Barrett's ulcer in a segment of oesophagus lined with gastric mucosa.

ILLUSTRATIONS

Case A. Y.

Overleaf are the illustrations of the preceding case consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

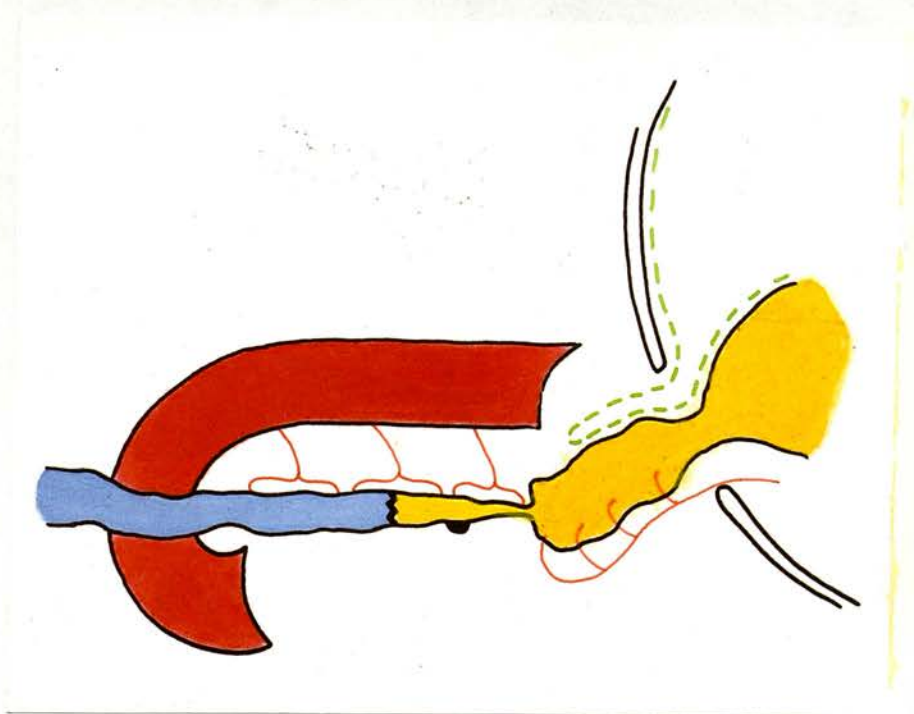
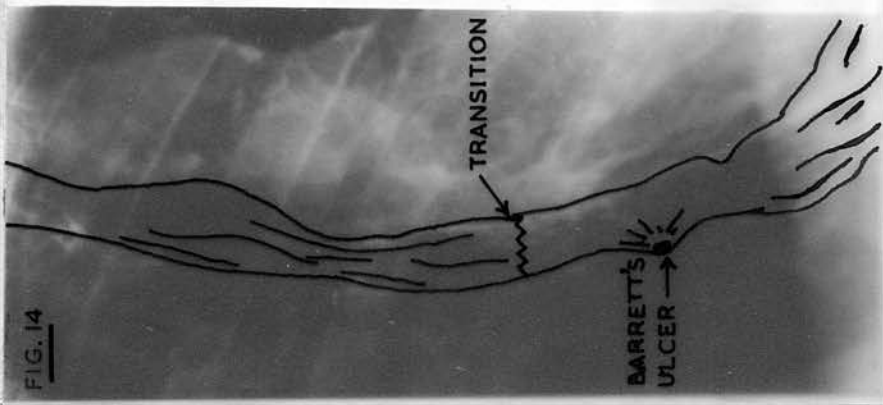
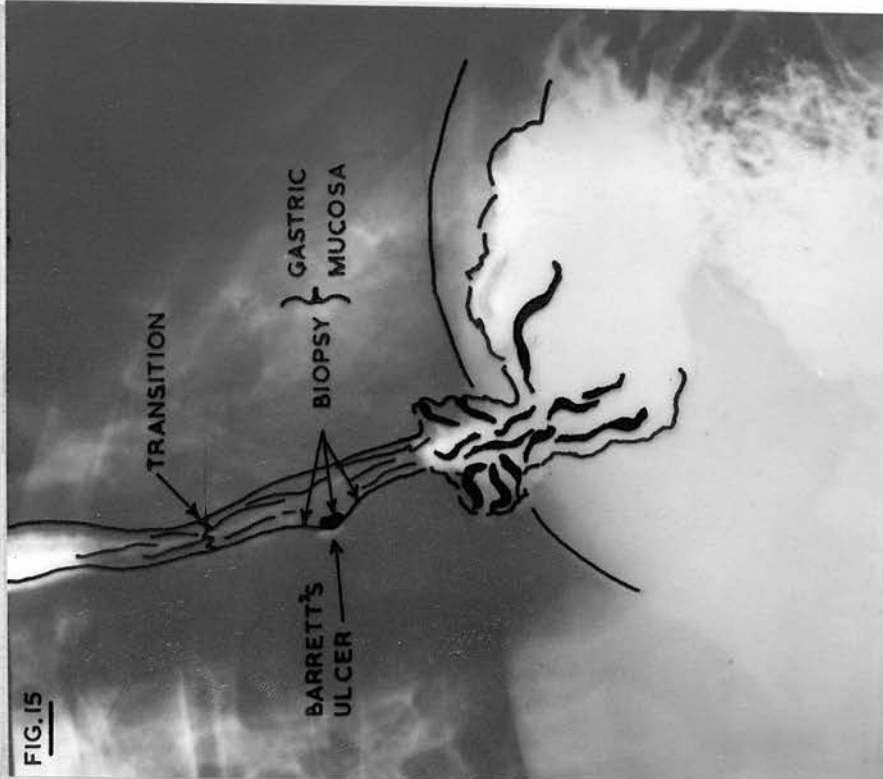


FIG. 16





CASE - V.F.

Female aged 49 years

ADMITTED 1955

COMPLAINTS

Heartburn for 5 or 6 years. Retro-sternal pain and dysphagia for one year.

HISTORY

For 5 or 6 years she has suffered from heartburn when she lies on her side at night. About one year ago she began to have retro-sternal pain at the level of the xiphisternum and difficulty in swallowing solid food. She also had vomiting or regurgitation of recently swallowed food.

PAST HISTORY

Encephalitis in 1923 and since then she has had post-encephalitic Parkinsonism. She has suffered from Reynaud's phenomenon for many years and X-ray showed calcinosis circumscripta.

BARIUM MEAL Fig.17.

There is smooth narrowing of the oesophagus for a distance of about one inch and a half mid-way between the carina and the diaphragm without evidence of hiatus hernia or reflux. Stomach and duodenum normal.

OESOPHAGOSCOPY

At 31 cms. there was typical peptic oesophagitis. The related stricture accepted a 10E bougie fairly tightly. It was dilated to 20E and tissue from within the stricture was sent for histology.



BIOPSY

Oesophageal stricture: The specimen consists of fibrino-purulent slough containing a few mucus producing columnar cells.

Ulcer membrane: Composed of felted pus cells.

OPERATION - Extract from operation notes

Standard left thoracotomy. No hernia or sac was appreciated in the region of the hiatus oesophagus^E. The gall-bladder, duodenum, pylorus and stomach were to sight and touch normal. The oesophagus was dissected in the mediastinum. At the lower pulmonary vein level there was a small firm mobile gland on the left wall of the oesophagus and above it there was an area of thickening of the oesophagus. This was judged to be the site of the stricture and it was calculated that the oesophagus should be resected to just below the aortic arch but the evidence was so slender it was considered that it would be necessary to open the oesophagus to make a firm decision when the moment came. The aortic sheath was reflected medially and the lowest oesophageal artery was demonstrated. This was shown to run sharply downwards and to divide into two branches which were distributed entirely below the area of induration of the oesophagus and to extend well below the small lymphatic nodule previously mentioned. The oesophagus was split upwards from its apparent junction with the stomach. The lower part was obviously lined with gastric mucous membrane. At the palpable area of induration the stricture was appreciated with sclerotic oesophageal wall around it and proximal to it the mosaic

pattern of the inflamed oesophageal mucous membrane. The "ulcer" itself was visible but as usual not very impressive. The oesophagus was divided through the mosaic patterned mucosa and the oesophago-gastric anastomosis completed.

PROGRESS

Much improved symptomatically but has had transient oesophagitis which had resolved at her last examination.

COMMENT

There was complete absence of any evidence of hiatus hernia both radiologically and at operation, nevertheless the tube below the stricture was lined with gastric mucosa and had an oesophageal blood supply. Radiologically the mucosal pattern below the stricture shows none of the heavy folds usually associated with gastric mucosa and is typically oesophageal. The absence of radiological evidence of reflux is noteworthy.

ILLUSTRATIONS

Case V. F.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

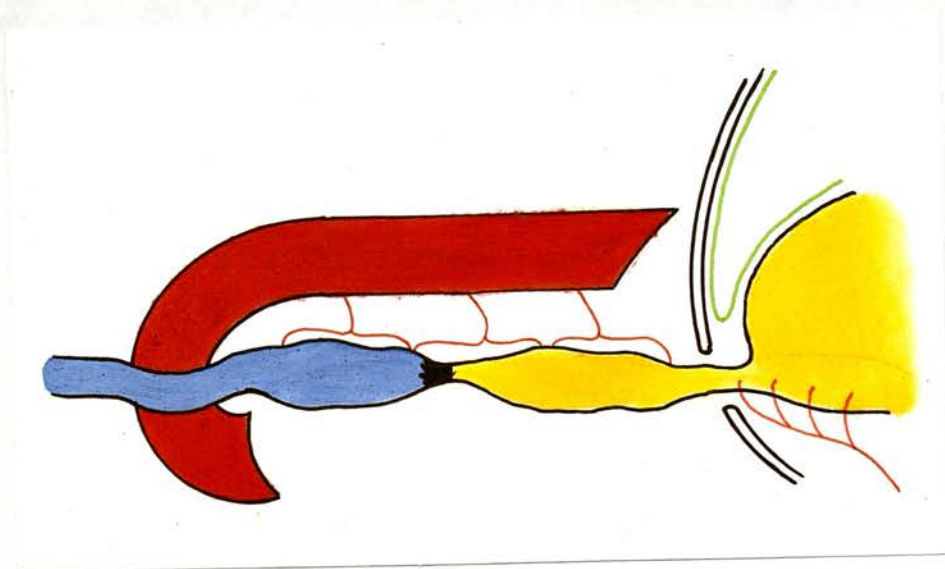
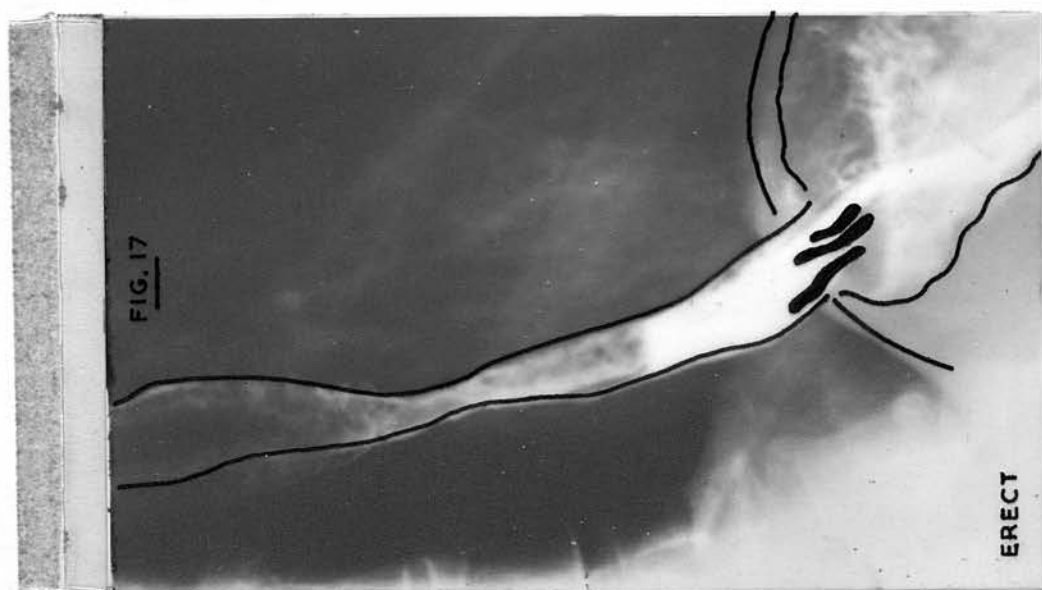


FIG. 18





CASE - W.G.

Male aged 59 years.

ADMITTED 1955COMPLAINTS

Dysphagia for four months.

HISTORY

For the last four months this patient has had difficulty in swallowing solid food. He has no trouble with fluids and can manage soft boiled eggs and soups, etc. He cannot swallow meat or dried bread and points to the xiphisternum as the place where his food sticks. He has not lost weight.

PAST HISTORY

Nil relevant.

BARIUM MEAL Fig.19.

There is a smooth narrowing in the gullet at the level of the carina. Below this the gullet again appears normal with a normal stomach and duodenum. Gastro-oesophageal reflux was produced with difficulty on only one occasion. There was no evidence of hiatus hernia.

OESOPHAGOSCOPY

At 28 cms. from the upper alveolus there was a stricture estimated at 14E size. So far as it was visible the mucosa was normal. A seeker into the stricture immediately produced bleeding. The presence of an ulcer within the stricture was presumed. No attempt was made at dilatation.

BIOPSY (from stricture)

Oedematous connective tissue with an incomplete covering of columnar epithelium. The epithelium forms

simple tubular glands and these are surrounded by numerous plasma cells.

OPERATION - Extract from operation notes

Standard left thoracotomy. There was no obvious herniation of the stomach. The stomach was mobilised. The oesophagus was mobilised in the posterior mediastinum by dissection in the immediate extra-oesophageal plane. The arterial supply of this apparent oesophagus between diaphragm and aortic arch was by transverse vessels from the aorta. The region of the stricture was apparent at the crossing of the left main bronchus as a densely sclerotic region firmly fixed to the para-oesophageal structures. The oesophagus was divided two inches proximal to the stricture. The stomach was divided and oesophago-gastrostomy was performed.

PATHOLOGICAL REPORT ON RESECTED SPECIMEN

1. Stomach.
2. Gullet above the diaphragm.
3. Oesophagus proximal to stricture.

Microscopic examination.

1. Shows normal gastric mucosa of fundic type.
2. Section shows mucosa which is atrophic - but consists of tubular mucous glands with some oxyntic cells present.
3. Section shows stratified squamous epithelium overlying a submucosa sparsely infiltrated with round cells and more compact lymph follicles.

PROGRESS

No symptoms referable to his oesophagus or stomach

ILLUSTRATIONS

Case W. G.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

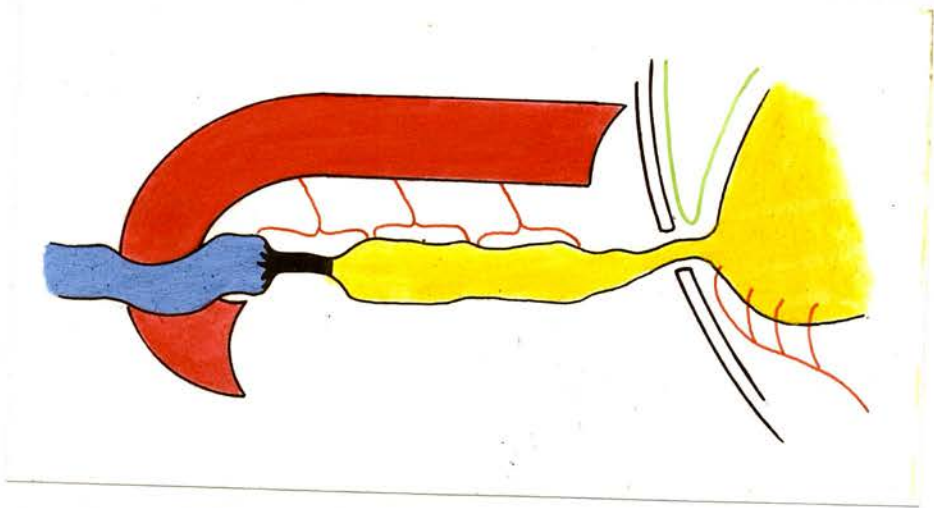
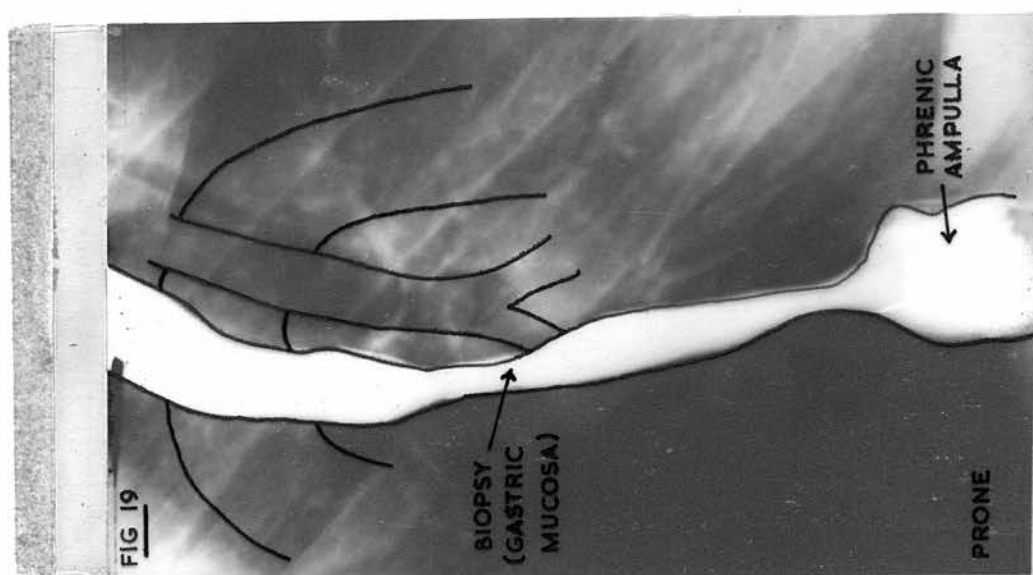


FIG. 20





CASE - I, McF.

Female aged 57 years

ADMITTED 1955

COMPLAINTS

Intermittent dysphagia^{and}/regurgitation for two years.

HISTORY

Up to two years ago this patient was entirely well when she began to notice her food sticking at the level of the suprasternal notch followed by regurgitation. She has suffered from this disability intermittently since. She has particular difficulty in swallowing anything tough or dry. Sometimes at night she has pain behind the sternum relieved by breaking wind. She has no history of epigastric pain or of heartburn.

PAST HISTORY

Winter bronchitis for many years. No pregnancies.

BARIUM MEAL Fig. 21.

Small short oesophagus type hiatus hernia with free reflux and smooth stricture in the gullet at the level of the aortic arch.

OESOPHAGOSCOPY

There was bile stained liquid in the proximal oesophagus the mucosa of which was normal. At 20 cms. from the upper alveolus were found the typical changes of peptic oesophagitis and a stricture reducing the lumen to 10E. There was constant reflux of bile stained liquid during the examination. No gastric mucosa was seen.

OPERATION - Extract from operation notes.

Standard left thoracotomy. There was a hiatus hernia of about 2" in depth, a peritoneal sac being anterior to it. The oesophagus was dissected in the mediastinum. One aortic branch went straight to the part of it, known to be lined with gastric epithelium. The oesophageal tube was mobilised up to and deep to the aortic arch. No abnormality was appreciated either to inspection or to palpation. An attempt was then made to locate the stricture. Beginning 1" below the lower border of the aortic arch, the oesophageal tube was slit upwards. It was lined by gastric mucosa as far proximally as it could be opened. The oesophagus was therefore mobilised between the aortic arch and the pleural dome. Still no abnormality was appreciated externally. The incision in it was carried upwards and just at the pleural dome, the peptic oesophagitis with a normal oesophageal mucosa above it were exposed for the first time. The oesophagus was divided through a part lined by normal oesophageal mucosa. The stomach was divided so as to remove $\frac{1}{4}$ of the greater curvature and $\frac{2}{3}$ of the lesser curvature. End to end oesophag^o-gastrostomy was performed.

DESCRIPTION OF RESECTED SPECIMEN

Resected specimen consists of the lower 2" of the oesophagus and the upper end of the "stomach". The upper end of the "stomach" is of the diameter of the oesophagus and has a mucosa which is typically gastric.

At the mucosal transition there is a narrowing of the lumen. This area is thickened and indurated and the naked eye appearances are those of peptic oesophagitis. At the upper end of the stomach there is a single vessel known to have arisen from the thoracic aorta supplying the upper end of the "stomach".

PROGRESS

Three days after the operation she collapsed suddenly and died. Post-mortem showed no obvious cause of death.

COMMENT

From the oesophagosopic findings and the descriptions of the resected specimen the mucosal transition can be localised to the gullet above the aortic arch where the stricture is seen radiologically. Between the stricture and the dome of the hernia was, at operation, a segment externally oesophagus and with oesophageal blood supply which is lined by gastric mucosa. This segment looks like normal gullet radiologically and there is no indication of the presence of gastric mucosa except by inference since the stricture from oesophagitis marks the mucosal transition.

ILLUSTRATIONS

Case I. McF.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and operative findings. The key to the coloured diagram is shown on page 23

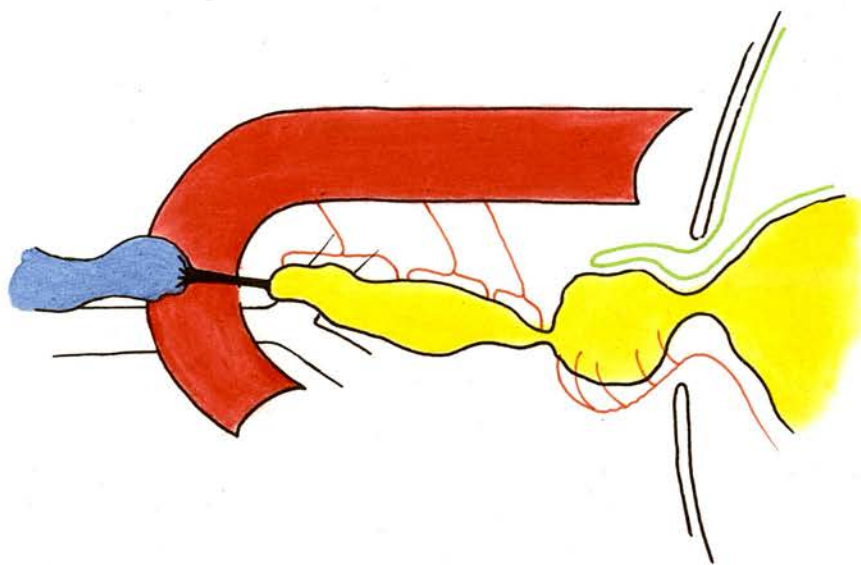
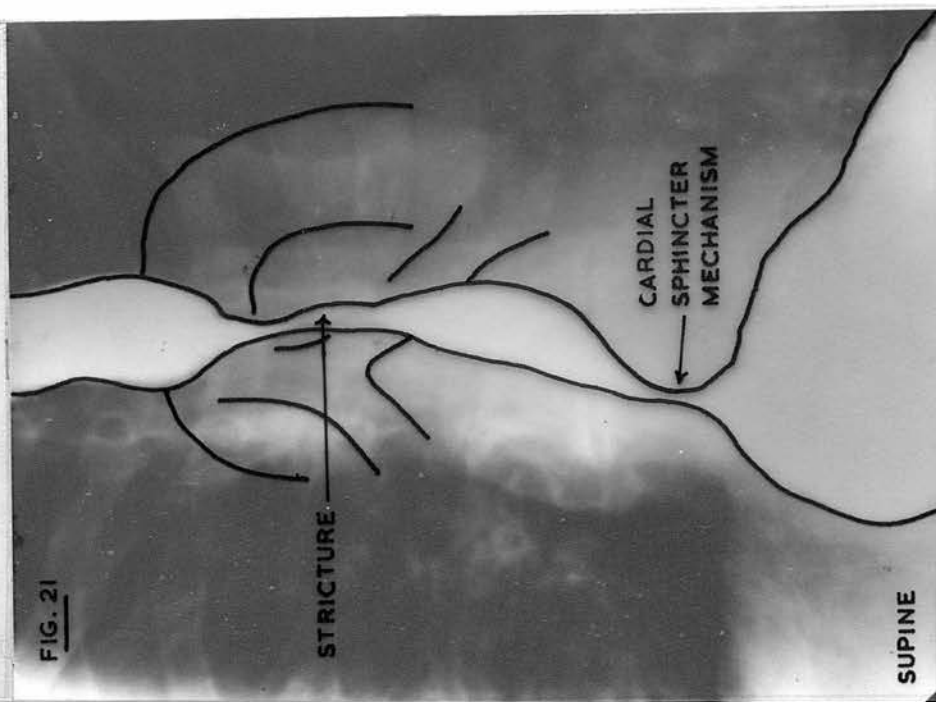


FIG. 22

FIG. 21





CASE - M.Co.

Female aged 60 years

ADMITTED 1955

COMPLAINTS

1. Epigastric pain and heartburn for four years.
2. Dysphagia for one year.

HISTORY

She was in perfect health till four years ago when she started to suffer from heartburn, epigastric pain and flatulence after food. The pain was not made worse by any particular type of food but she obtained some relief from bicarbonate of soda. She was treated by her doctor with "powders" and noted some improvement till one year ago when she noticed pain behind the sternum at the level of the fourth cartilage when she swallowed solid meat. This symptom became progressively worse till she could barely swallow her saliva for the pain. She complained on one occasion of meat actually sticking for a period of five minutes at the same site. She was admitted to the Royal Infirmary where she was treated with bougies and subsequently her swallowing improved. She did, however, notice regurgitation especially on stooping.

PAST HISTORY

She has had three deliveries. The first requiring forceps, the second pelvic floor repair and the third Caesarian section and she has had another pelvic floor repair since. She also suffered from "slipped disc" six years ago.

STOOL BENZIDENE

Positive.

BARIUM MEAL Fig. 23.

Hiatus hernia of the short oesophagus type, which does not reduce in the erect position. There is narrowing at the lower end of the gullet but no significant obstruction to the barium flow. There was free regurgitation. No definite ulceration demonstrated, in the rest of the stomach. Duodenum: Negative.

OEESOPHAGOSCOPY

There was peptic oesophagitis and mild stricture formation at 32cms. Tissue just distal to the stricture was removed for histological examination.

BIOPSY

The specimen consists of glandular mucosa lined throughout by clear mucous producing columnar epithelium with some oxyntic cells present. Fig. 25.

OPERATION - Extract from operation notes.

Standard left thoracotomy. A small hernial dome was seen in the pulmonary ligament and on close examination was obviously a herniation of the stomach with a sac lying anteriorly and slightly to the right. This was easily reduced. The liver, stomach, duodenum, gallbladder and pancreas were all normal. The hernial dome was exposed by incision of the posterior layer of the pulmonary ligament. In order to ascertain the vascular supply, the aortic sheath was incised. The lowest oesophageal artery arose directly from the aorta and was traced in its whole length.

It divided into two and its lower branch passed to the right on the hernial dome within the oesophageal sheath. The artery was running downwards at this point. The hernia was reduced and the hiatus narrowed.

PROGRESS

Asymptomatic three years after her operation. Barium meal more than one year after the operation showed no hiatus hernia and no regurgitation. There is a little narrowing of the gullet just above the hiatus but with little hold-up of the barium flow. No post-operative oesophagoscopy was performed.

COMMENT

From the operation notes it is apparent that a portion of the intra-thoracic viscus which is lined by columnar epithelium has an oesophageal blood supply. It appears from the X-ray that there is, between the stricture and the gastric dome, a short tube-like segment which looks more like gullet than stomach and although we know from the biopsy that is lined with columnar epithelium it has no gastric characteristics radiologically.

ILLUSTRATIONS

Case M. Co.

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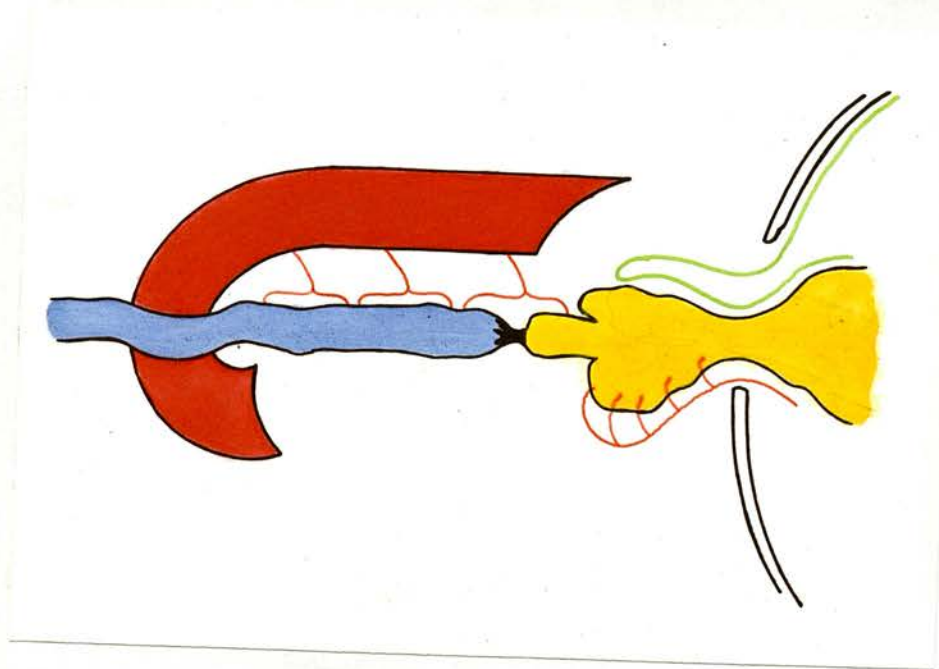
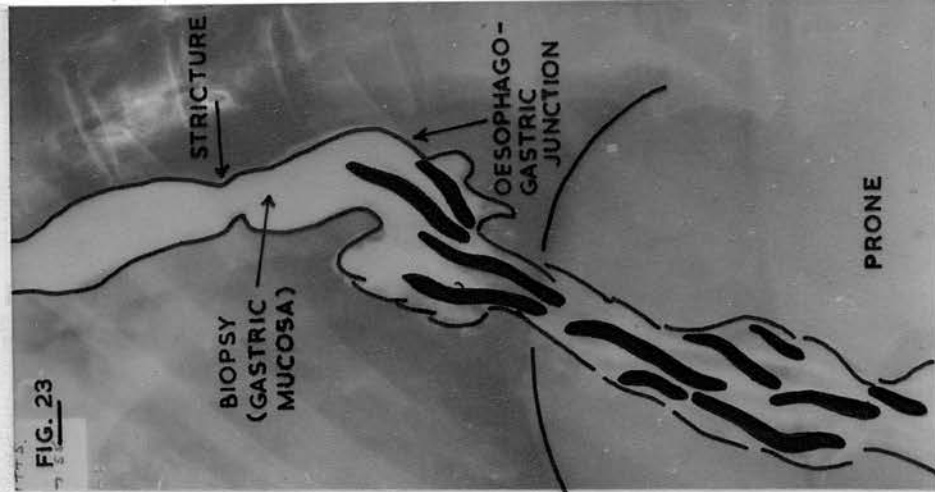


FIG. 24

FIG. 23





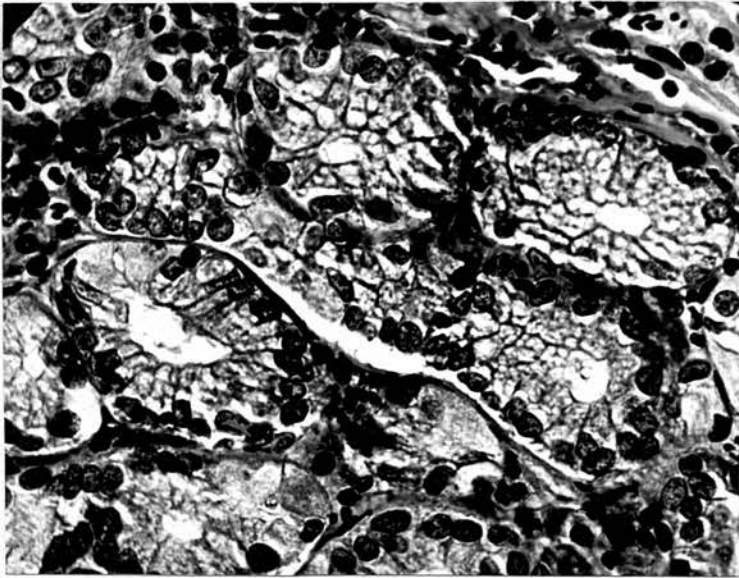


Fig.25

Biopsy just distal to the stricture at 32cm.
showing oxyntic cells stained by a special
method.(Mark Drysdale)

CASE - M.C.

Female aged 75 years

ADMITTED 1955

COMPLAINTS

Regurgitation, dysphagia and loss of weight for six years.

HISTORY

During the last six years this patient has had regurgitation, worse during the last three months. It was worst when she bent down to scrub the floors. Food often sticks at the level of the lower end of her sternum with a feeling of tightness which is only relieved by bringing up the food. She has been losing weight.

PAST HISTORY

She has had one child. She was fairly well prior to the last six years except for a vague history of indigestion and of taking stomach powders.

BARIUM MEAL Fig. 26.

There is a constriction in the oesophagus at the level of the carina. A hiatus hernia exists with free regurgitation when the patient is supine. The abdominal part of the stomach appears to be normal as is the duodenal cap.

OESOPHAGOSCOPY

At 24cms. from the upper alveolus were seen the typical appearances of peptic oesophagitis. The stricture lay at 26cms. entirely surrounded by yellow membrane. It would admit a 16E. bougie.

OPERATION

Standard left thoracotomy. There was a small hiatus hernia, the peritoneal sac passing upwards in the anterior and left part of the hiatus. The duodenum was normal. It was considered that on account of the height of the stricture, displacement of the oesophagus below the diaphragm was improbable and therefore gastro-oesophageal resection was undertaken. The oesophagus was mobilised from arch to diaphragm in the immediate gastro-oesophageal plane. The stomach was divided. The oesophagus was divided at the lower border of the aortic arch. End to end oesophago-gastrostomy was performed.

RESECTED SPECIMEN

The specimen consists of a segment of lower oesophagus and "proximal part of the stomach". The oesophagus generally is thickened and probably leucoplakic. There is a small ulcer $1\frac{1}{2}$ cms. proximal to the naked-eye gastro-oesophageal junction which appears to be epithelialising.

MICROSCOPIC EXAMINATION

On section, stratified squamous epithelium occurs only at the upper limit of resection and as a minute island just distal to this. The remaining lining consists of generally atrophic chronically inflamed columnar cell tubular mucosa. However, in at least one area of the 'naked-eye' oesophagus there are well formed submucosal oesophageal type glands which indicate that the overlying mucosa is columnar by either metaplasia or ectopia.

Section through the ulcer reveals a shallow lesion not penetrating deeper than the submucosa, which is

generally thickened by fibrosis and chronic inflammatory cell infiltration.

The remainder of the wall shows no abnormality.

PROGRESS

Four months after the operation the patient had no dysphagia and could swallow anything. Unfortunately she had no appetite and has lost a stone and a half in weight since discharge. She has not been seen since.

COMMENT

The oesophagitis and stricture are endoscopically shown to be just below the aortic arch, the site of the radiological stricture. The fact that the segment below the stricture is lined with gastric mucosa is confirmed by the pathologists' report on the resected specimen. Barium demonstration of hiatus hernia is confirmed at operation and a peritoneal sac shown. There was no direct radiological evidence of gastric mucosa between the hernia and the stricture but the fact that gullet is lined with gastric mucosa can be inferred from the fact that the stricture usually marks the mucosal transition and the lower end of the gullet is indicated by the constriction of the cardiac sphincter mechanism. The irregularity of the contour of the segment lined with gastric mucosa, as shown radiologically, indicates tertiary waves and is additional evidence in favour of an oesophageal musculature.

ILLUSTRATIONS

Case M. Cu.

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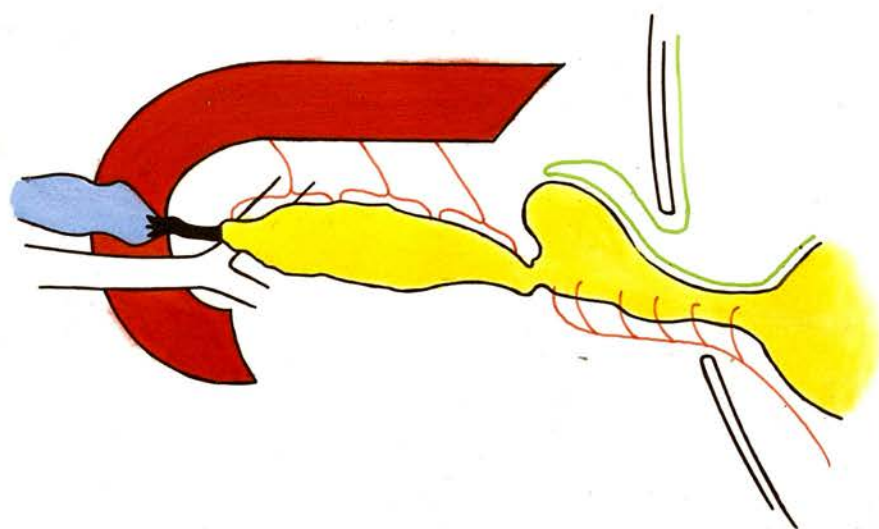
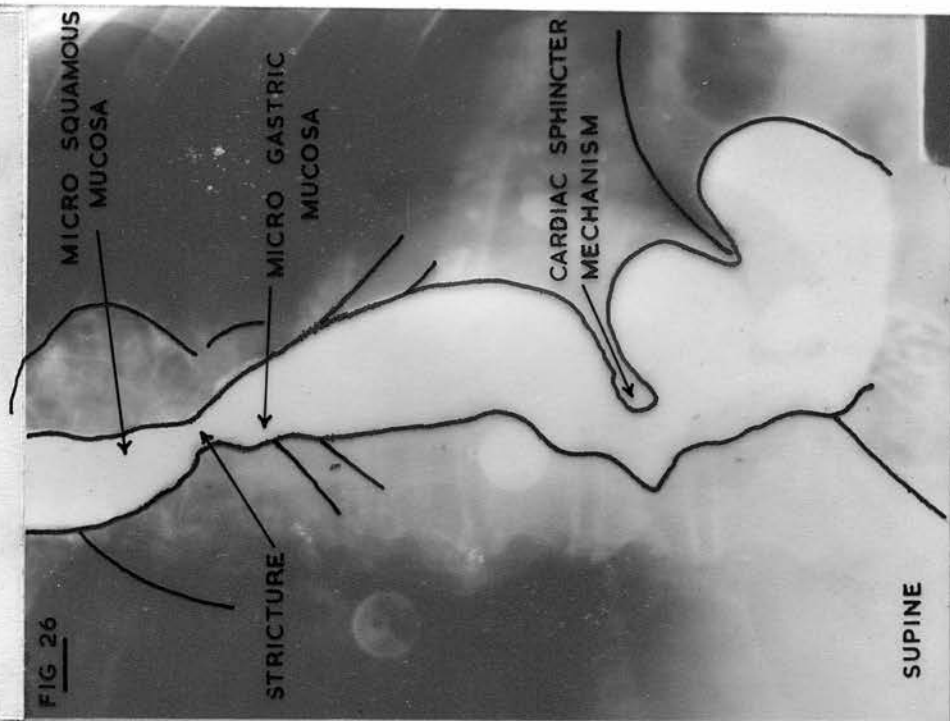
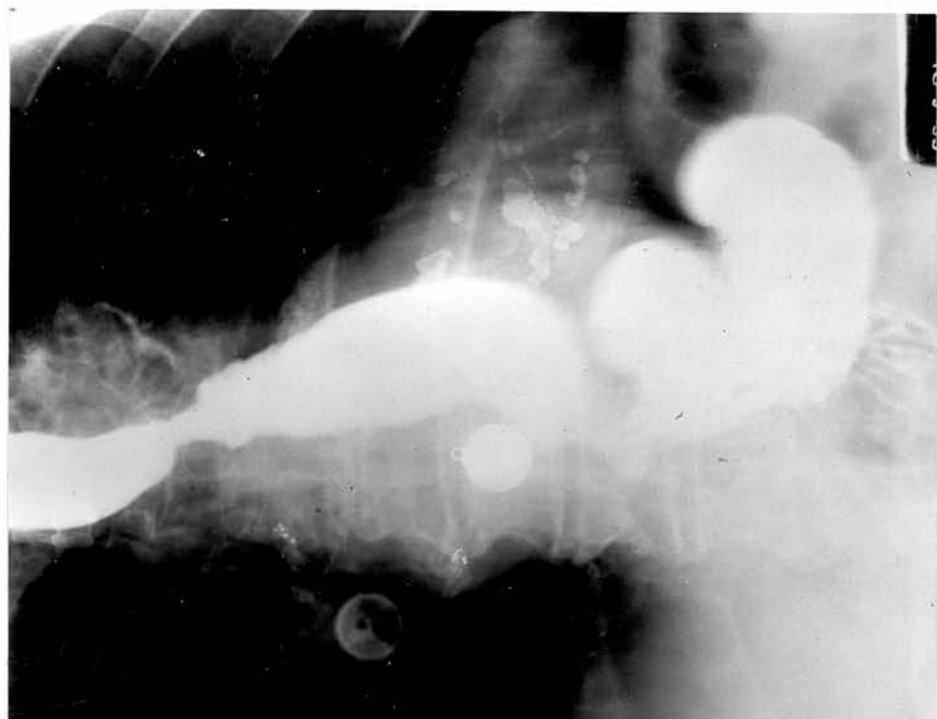


FIG. 27

FIG 26





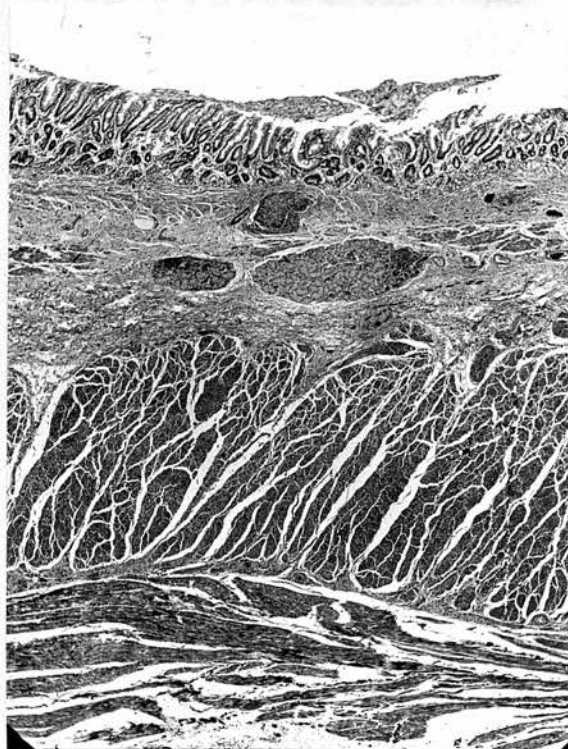


Fig.28

Section of gastric mucosa showing deep oesophageal
mucous glands deep to the muscularis mucosa.

Stained H.&E.

CASE - C.M.

Female aged 58 years

ADMITTED 1952

COMPLAINT

Epigastric pain for five years.

HISTORY

For five years she has suffered from epigastric pain. This pain comes on an hour after food and is relieved by alkalis. It is associated with heartburn, flatulence, waterbrash and pain in the back. Lying and stooping aggravate the symptoms and lying on the left side eases it. When she eats too much she regurgitates immediately. She sometimes "feels food sticking at the bottom end of her gullet" and when she regurgitates it, it does not seem to her that the food has ever been in her stomach. She has lost one and a half stones in five years.

PAST HISTORY

In 1949 she had a barium meal showing a para-oesophageal hiatus hernia. She was seen by a surgeon who advised against operation. She was very anaemic at that time but responded well to iron.

BARIUM EXAMINATION -(prior to the first operation) Fig.29

A large para-oesophageal hiatus hernia was found to be present and in addition to the fundus a small portion of the body of the stomach was also herniated producing a degree of volvulus of the stomach.

OPERATION

The defect in the diaphragm was found to the right side

of the normal oesophageal orifice and through this the fundus of the stomach herniated into the chest. The abnormal opening was large enough to admit the whole hand without difficulty. The stomach was drawn down, and, as far as could be judged (the access being poor) was delivered into the abdomen. Repair of the hernial defect was carried out.

IMMEDIATE POST-OPERATIVE BARIUM EXAMINATION Fig. 31

She now has a short oesophagus type hiatus hernia with the oesophago-gastric junction well above the hiatus and with free reflux.

ADMITTED THORACIC SURGICAL UNIT 1955

COMPLAINT

Dysphagia for two years.

HISTORY

This patient had an operation for para-oesophageal hiatus hernia in April 1952 in another hospital. The reduction was effected by the abdominal route. She felt well for one year afterwards and then she had several episodes of choking while swallowing dry food. In the following two years these episodes have become more frequent. She has had no pain on swallowing but there was a sensation of the oesophagus being full. She then choked and regurgitated. There was no nausea or vomiting and the regurgitated material did not contain blood or bile. The difficulty in swallowing has become progressively worse and for the past two months the patient has only been able to swallow liquids and has lost twelve pounds in weight in the last three weeks.

BARIUM EXAMINATION - (prior to second operation) Fig. 32

Short oesophagus type hiatus hernia with a simple stricture at the level of the aortic arch. Between the stricture and the dome of the hernia there is a considerable segment of normal looking gullet.

OESOPHAGOSCOPY

Oesophagus was full of food debris including a lump of meat. At 24 cms. from the upper alveolus the lumen was reduced to an apparent 3 mms. diameter round which were typical changes of peptic oesophagitis. There was constant reflux through the stricture. Tissue from within the stricture was removed for histological examination.

BIOPSY

Fragmental acini lined with mucous secreting columnar epithelium.

OPERATION

Standard left thoracotomy. The bulge of the hiatus hernia was immediately obvious in the pulmonary ligament. The dome of the hernia and the oesophagus above it were dissected. No abnormality of the oesophagus was appreciated till the dissection was carried above the aortic arch. Immediately deep to this there was an area of dense sclerosis fixed to the left bronchus and the aortic arch. This was judged to be the site of the stricture and also the junction of oesophageal and gastric mucosa. The stomach was divided, and the oesophagus was divided between the aortic arch and the dome of the pleura and end to end oesophago-gastrostomy was performed. It was obvious that

the stricture was removed with the specimen and very little oesophageal mucosa could be found at that level. All the rest was gastric mucosa. A careful dissection of the lowest oesophageal artery was made. It was demonstrated within the aortic sheath and traced through it and was found to be distributed to the summit of the dome and to the immediately adjacent tubular part of the oesophagus. The general direction of this vessel was downwards.

COMMENT

This case is of great interest. The fact that she had a high transition was not apparent till after her para-oesophageal hernia without reflux was converted into a short oesophagus type hiatus hernia with reflux. Endoscopic examination placed the transition at the level of the aortic arch and this was confirmed at operation and by biopsy. The site of the transition is the site of the stricture shown radiologically. The tube between the stricture and the hernial dome looked at operation externally like normal oesophagus and had an oesophageal blood supply. The fact that this segment was lined by gastric mucosa can be inferred since the stricture usually marks the mucosal transition, but it is important to note that this segment was quite indistinguishable on radiographic criteria from oesophagus lined with squamous mucosa.

Case C.M.

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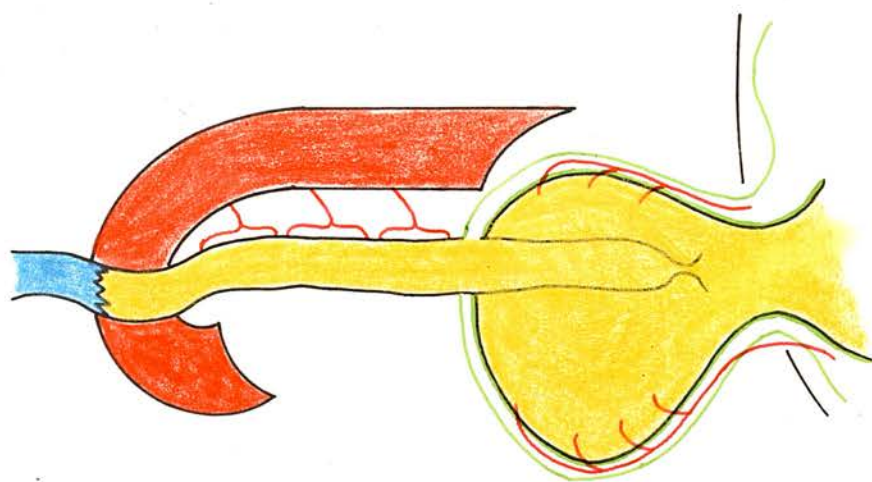
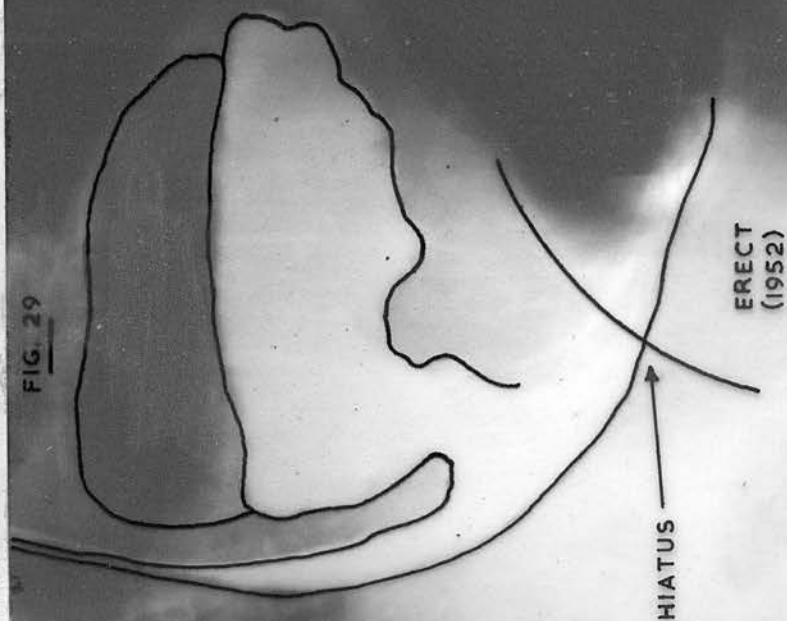
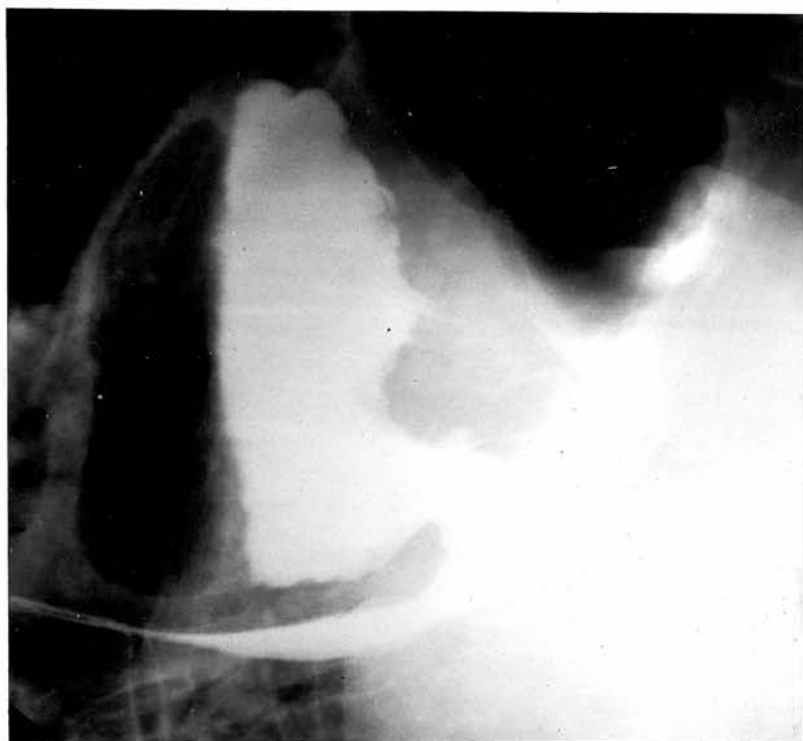


FIG. 30

FIG. 29





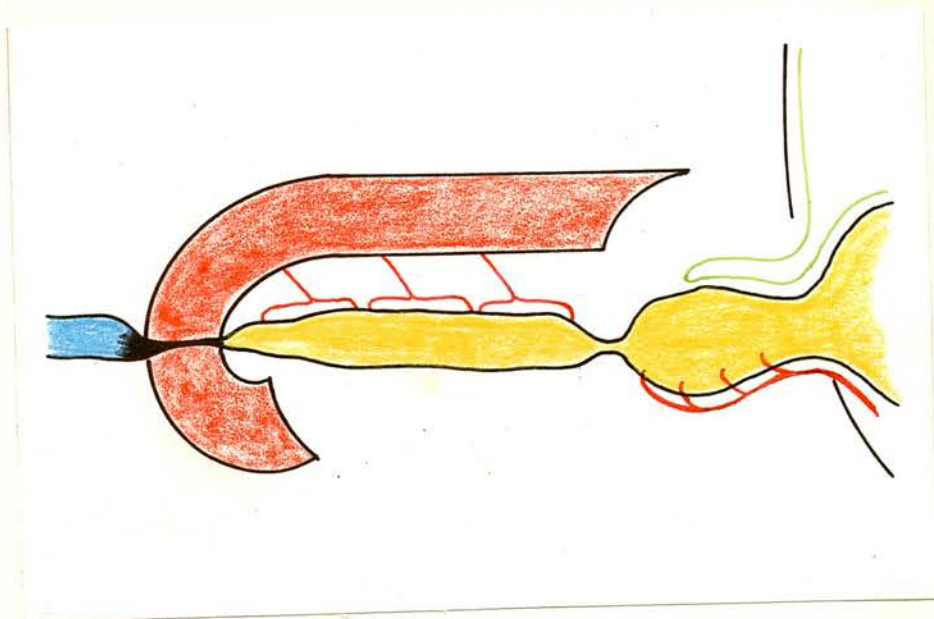
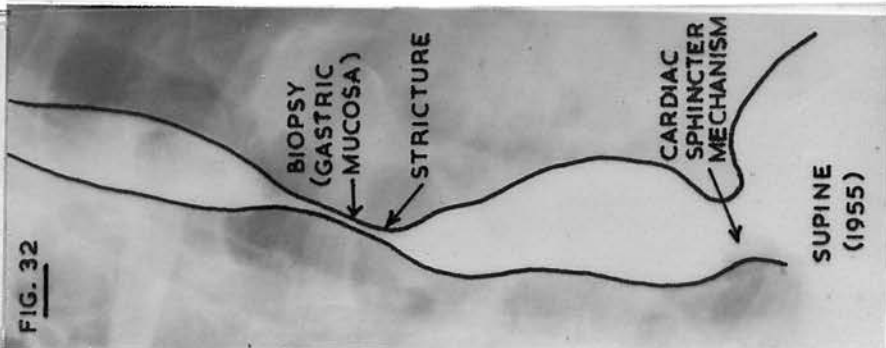
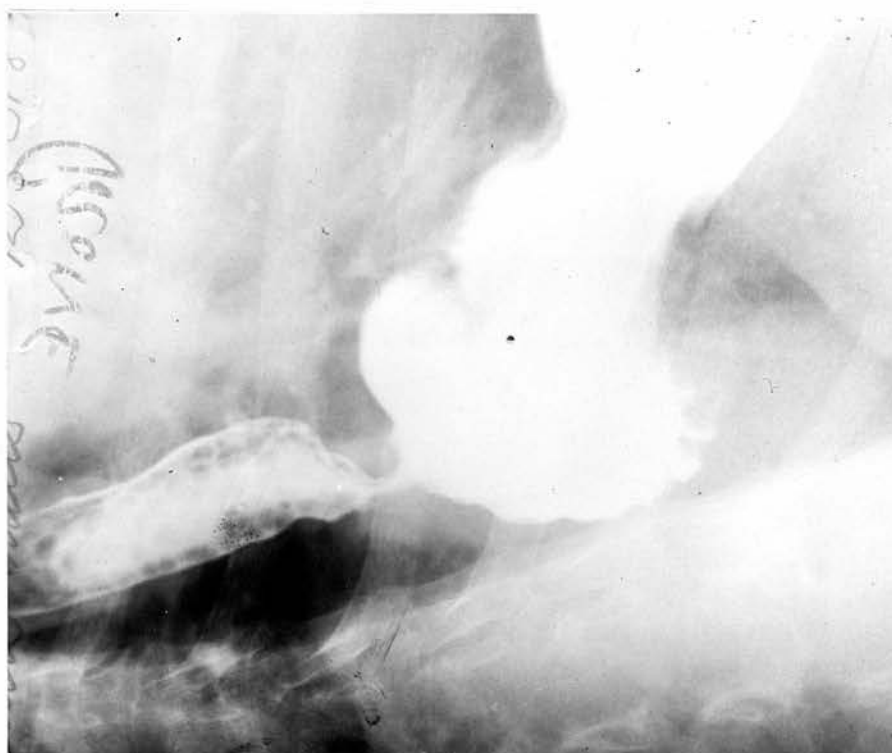
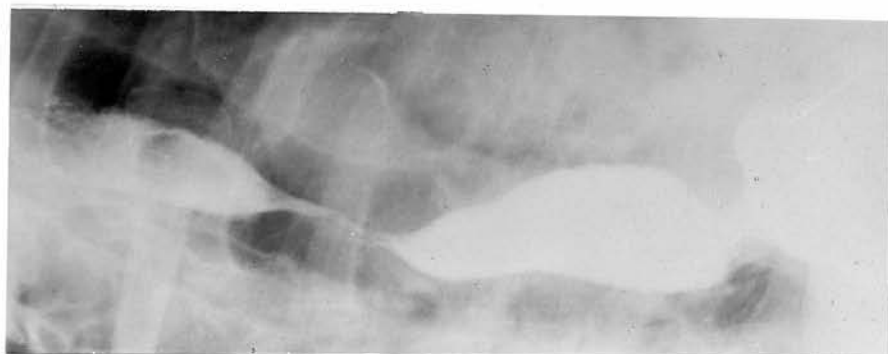


FIG. 33





CASE - J.Su.

First seen 1955

Female aged 71

This case was seen at another hospital in the Northern Group and not at the Thoracic Surgical Unit. The radiographic features of this case are so interesting that it has been included in the series.

COMPLAINT

Dysphagia for six months.

HISTORY

This patient has complained of increasing dysphagia over the last six months. Solid food was held up behind the manubrium and if forced on with fluids it caused pain. Regurgitation of food sometimes occurred. She has lost one stone in weight over the last six months and at the time of admission was reduced to a fluid diet only. There has been indigestion for years but no heartburn.

BARIUM EXAMINATION Figs.34 and 35.

Narrow stricture at the level of the aortic arch with a circular ulcer niche just below the stricture. There is also a hiatus hernia present with moderate regurgitation.

OESOPHAGOSCOPY

Typical changes of oesophagitis with an associated stricture at 24cm. Following dilatation, an aspiration biopsy was taken of the mucosa below the stricture.

BIOPSY

This showed mucous secreting columnar epithelium with a few oxyntic cells present. (Fig. 37)

PROGRESS

She was treated medically and with bouginage and was discharged. She remained well until early in 1956 when bouginage began to be more difficult. She was re-admitted but in spite of gastrostomy she continued to deteriorate and she developed haematemesis and melaena which was uncontrollable and in spite of blood transfusions she died. A post-mortem was performed.

PATHOLOGIST'S REPORT

The oesophagus is stenosed at the level of the arch of the aorta. The stenosis is almost complete, the lumen being reduced to a minute diameter. The stenosed segment seen on section shows no mucosal lesion and only fibrosis in the muscle layer. Below the stenosis there is a dilated segment which is lined with gastric mucosa. The left lateral and anterior surfaces of part of this segment is ulcerated, the base of the ulcer being formed by very dense fibrous tissue and on the ulcerated wall a large blood vessel with eroded wall can be seen lying on the surface. Microscopic examination proximal to the stricture shows normal squamous mucosa. Section from the ulcer site shows that the epithelium on both sides of the ulcer is composed entirely of mucous secreting columnar cells forming simple tubular glands and deeper tubulo-racemose glands, and is exactly the same as that lining the cardiac part of the stomach. The ulcer is non-specific inflammatory ulceration.

COMMENT

Endoscopically the mucosal transition is at the level of the arch of the aorta, the site of the stricture shown radiologically and this is confirmed by biopsy and at post-mortem. Between the stricture and the hernia there is a segment of radiologically normal oesophagus with no indication that it is lined with gastric mucosa apart from the presence of a well marked ulcer niche below the stricture which is obviously^a/penetrating ulcer which does not occur in squamous mucosa and infers that the lining is gastric. The fact that the stricture nearly always marks the mucosal transition is another indication of this state of affairs.

ILLUSTRATIONS

Case J. Su.

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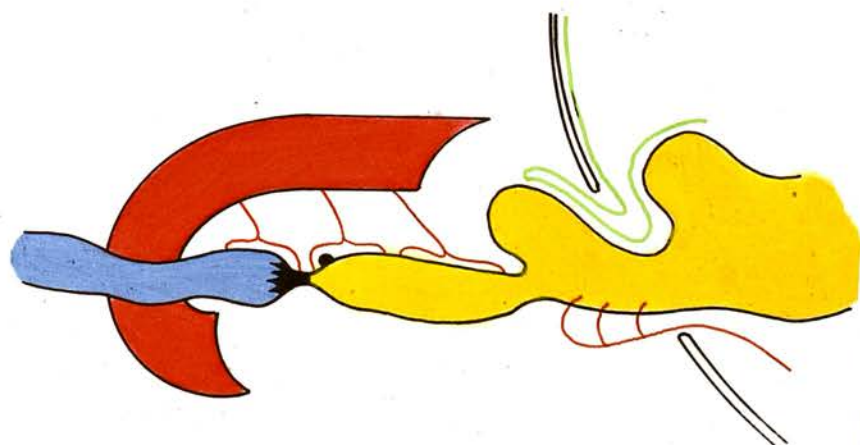
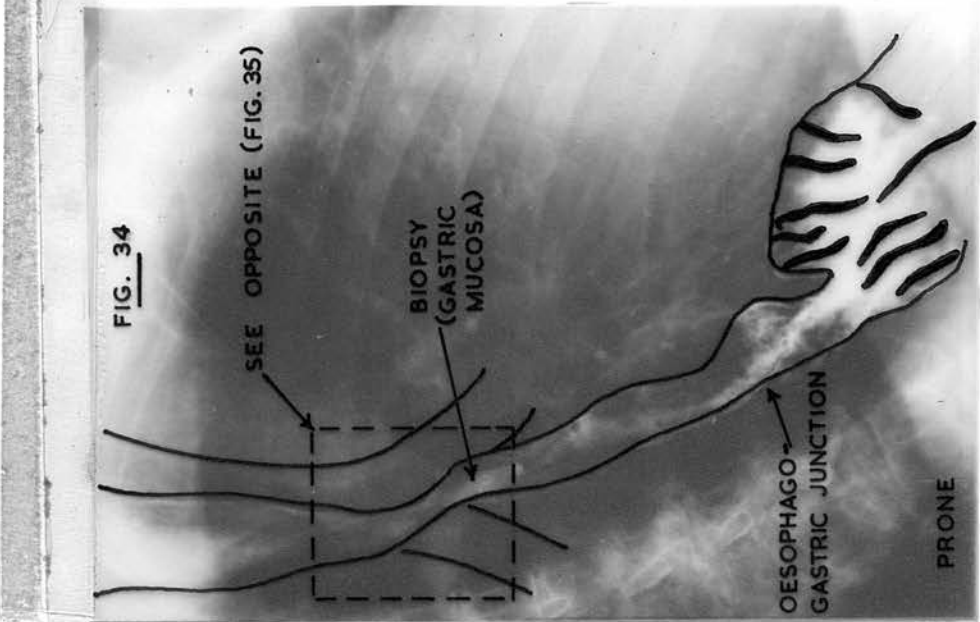
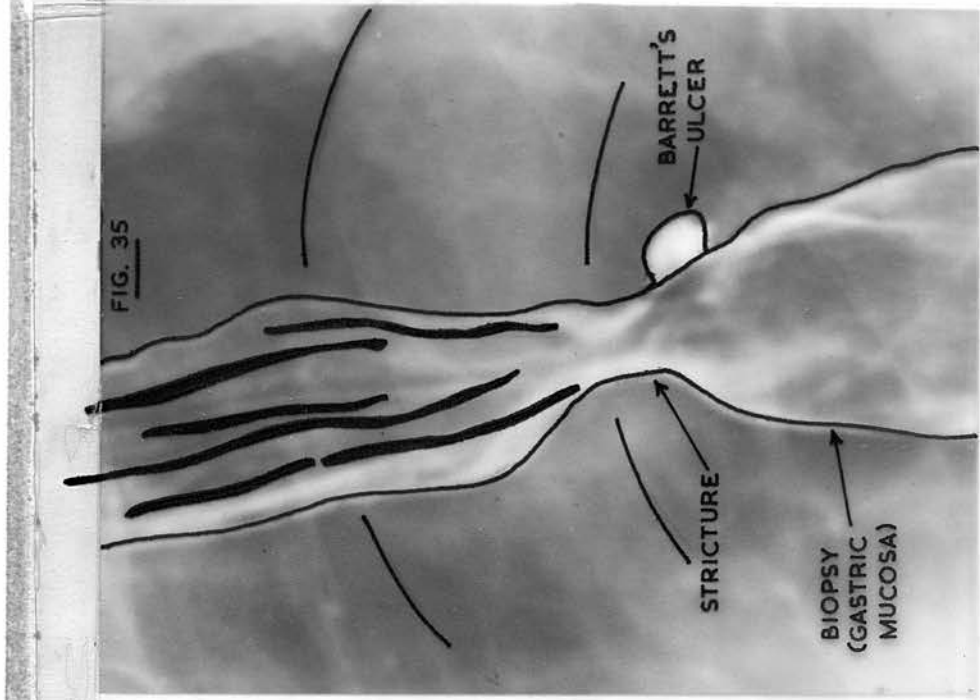
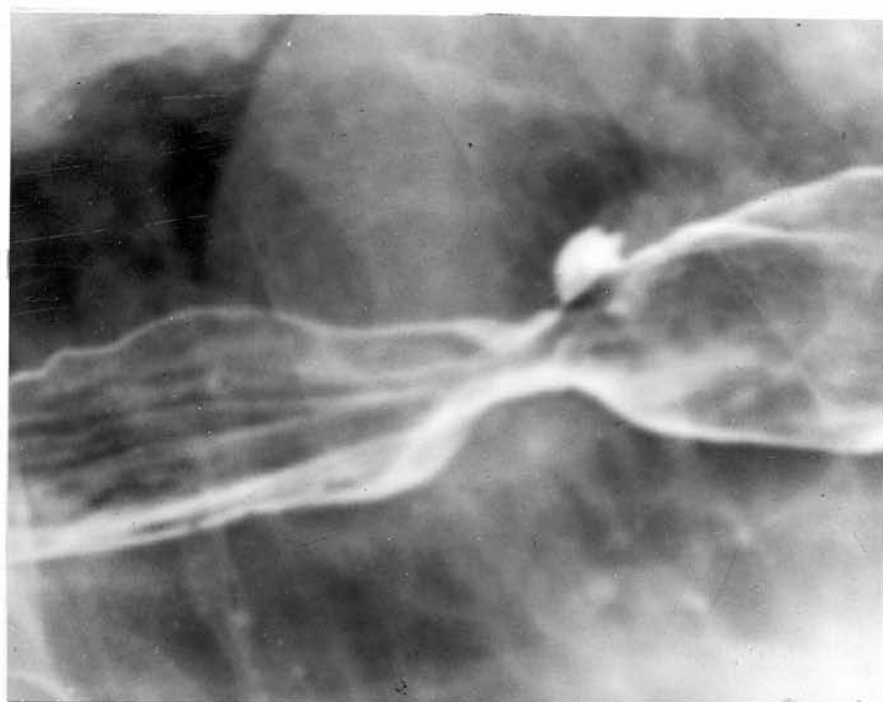


FIG. 36





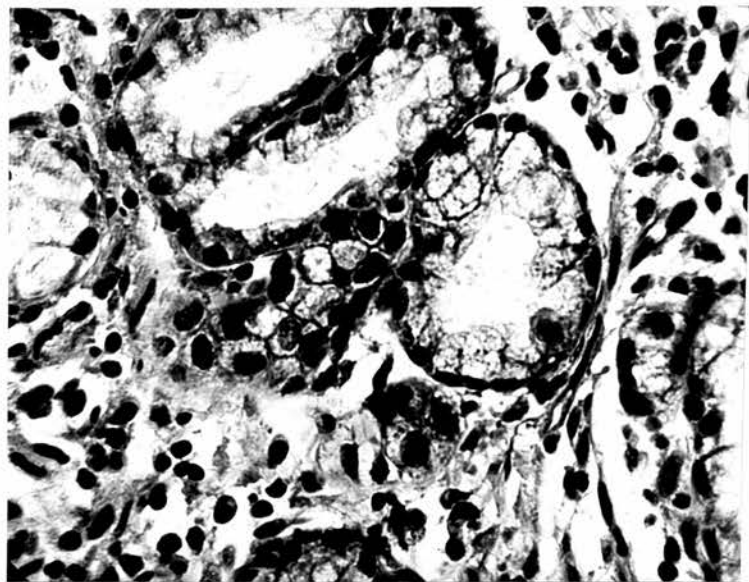


Fig.37

Biopsy from 26cm.(the level of the left main bronchus) showing oxyntic cells stained H.&E.

CASE - M.E.

Female aged 49 years

ADMITTED 1955

COMPLAINTS

Retrosternal pain for 35 years.

HISTORY

At the age of fourteen she first experienced an aching or burning pain behind the lower end of the sternum coming on about one hour after meals and relieved to some extent by taking alkalis. She has had this pain after nearly every meal since and the longest remission she has had was for a period of one week at the time of her cholecystectomy in 1947. The pain was brought on by any kind of food except milk which often relieved it. The pain radiated to the back at times but never to the epigastrium. She has never had difficulty in swallowing or any sensation of food sticking. She has vomited at times but not frequently. She is often wakened at night by the pain but recently she has slept with three pillows and has had less pain at night. She does not suffer from heartburn or regurgitation on stooping or bending. She takes large quantities of alkalis - half a pound of powder in three weeks and a hundred Rennies tablets weekly. She has been doing this for many years. Her appetite is good and she has not lost weight.

PAST HISTORY

Cholecystectomy and appendicectomy in 1947.

BARIUM MEAL Fig. 38.

Free gastro-oesophageal reflux with small hiatus hernia. There is a small ulcer crater in the oesophagus just above the gastric dome. She has a right sided aortic arch.

OESOPHAGOSCOPY

Gastric liquid lay in the oesophagus and constantly flowed into it from stomach. An irregular junction of oesophageal and gastric mucosa lay at 24 cms. and there was no evidence of oesophagitis or stricture. Tissue was taken from below the transition for histology.

BIOPSY

Section shows mucosa of gastric cardiac type.

OPERATION

Standard left thoracotomy. The relations of the subphrenic part of the stomach gave no indication of herniation into the mediastinum. The fixation of the stomach at the cardia looked normal. The oesophagus was explored. The part below the vena azygos was thick and heavy but no localised lump could be felt in it. On the other hand there were enlarged glands along the course from the left gastric artery to the crossing of the vena azygos which was on the left side. For this reason it was decided to accept that there was an ulcer in the "supraphrenic part of the stomach". The left gastric artery bore the normal relationship to the subphrenic part of the stomach. The oesophagus was divided at the level of the crossing of the vena azygos

although there was no external indication that the junction of gastric and oesophageal mucosa lay there.

DESCRIPTION OF RESECTED SPECIMEN

The specimen consists of a portion of stomach wall. There is a vague straight constriction roughly at the mid-point of the specimen at the site of the diaphragmatic hiatus. Below this, the mucosa presents the normal rugose pattern of normal stomach. Above this line the rugosities run in a predominantly paralalled fashion. There are two small areas in the supra-diaphragmatic part which could be mucosal eroisions, but from naked-eye examinations it is impossible to say.

MICROSCOPIC

The supra and infra-phrenic zones present the following features:-

1. The supra-phrenic mucosa consists entirely of simple tubular glands of mucus-secreting columnar epithelium.
2. The infra-phrenic mucosa corresponds to gastric fundus type, containing chief and oxyntic cells. The appearance of the muscularis mucosa, the musculosa and the elastic tissue give no indication whether the supra-phrenic part is stomach or oesophagus.

There is a small mucosal deficiency in the supra-diaphragmatic zone - not penetrating the lamina muscularis mucosa - which is lined by a single layer of tall columnar cells without gland formation. It probably represents epithelialisation of a small acute ulcer.

PROGRESS

Five years after the operation this patient was free from any alimentary symptoms.

COMMENT

Endoscopically the transition from oesophageal to gastric mucosa was at the aortic arch and this was confirmed histologically. The segment below, at operation, looked externally as oesophagus and had an oesophageal blood supply. Radiographically this segment had no differentiating features from normal gullet and the presence of gastric mucosa and a high transition was in no way apparent. There was a hiatus hernia demonstrated by barium examination which was not noted at operation and one presumes that it was self-reducing. This has not been included in the colour diagram of this case. There was radiological evidence of a Berrett's type ulcer at the lower oesophagus and the presence was confirmed at operation by related glandular enlargement. The pathologist noted a healing acute ulcer at the same site, this is not entirely consistent with the length of the history of retrosternal pain or the radiological appearances but the point could not be further clarified.

ILLUSTRATIONS

Case M. E.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and histological findings. The key to the coloured diagram is shown on page 23

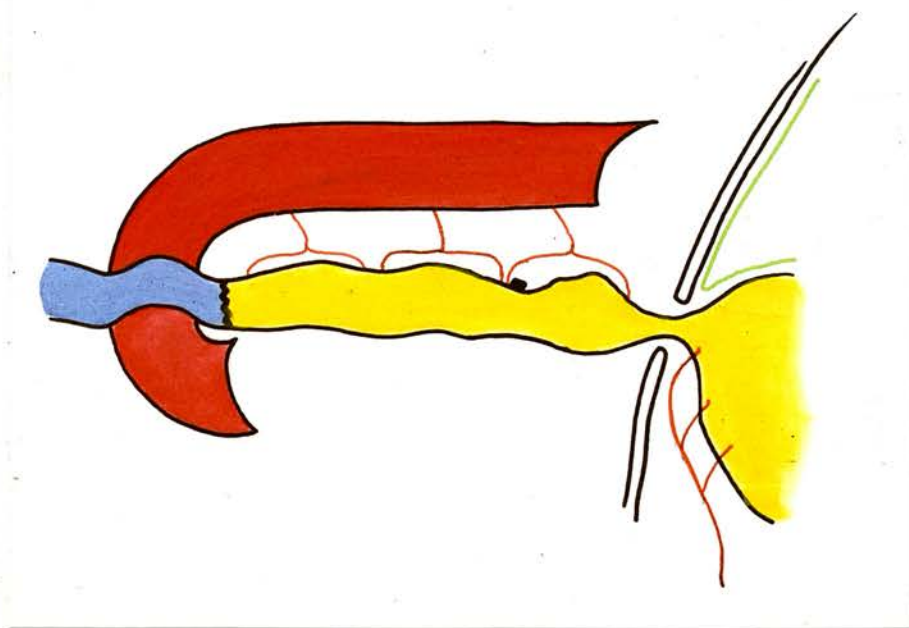
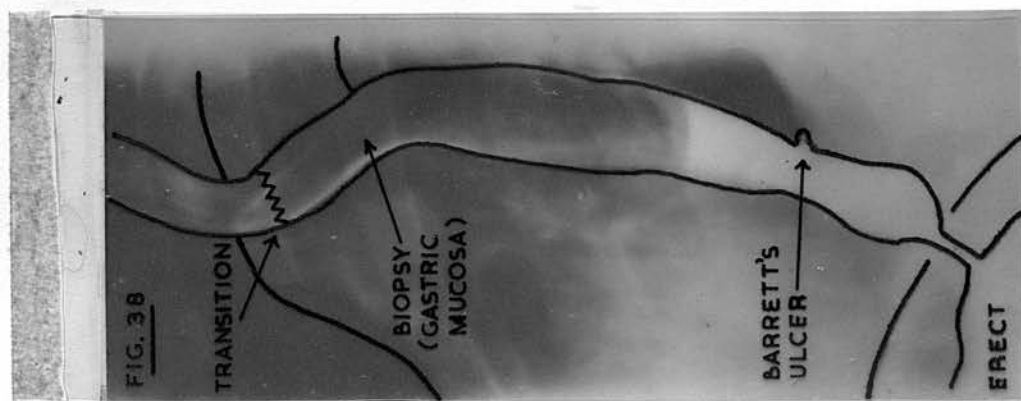


FIG. 39





CASE - A.W.

Male aged 67 years

ADMITTED 1956

COMPLAINTS

- 1) Epigastric pain and heartburn for eight years.
- 2) Regurgitation for three years.
- 3) Recent haematemesis.

HISTORY

For eight years this patient had operations on his hip joint and received tablets of Butazolidin and at that time he noticed epigastric pain coming on before meals relieved by food for one hour, then returning. The pain has persisted on and off ever since and has never been relieved for more than two hours at a stretch. During the last three years when he takes food, he regurgitates some shiny white liquid and a little food. He also has had heartburn. Sleep is difficult since he cannot lie on his left side without discomfort. Three times a night he wakes feeling hungry and eats biscuits. One month ago he vomited up a cupful of blood and subsequently noticed that his stools were black. He has had no haematemesis subsequently.

PAST HISTORY

Eight years ago he had operations on both hips for osteo-arthritis.

BARIUM MEAL Fig.40.

Short oesophagus type hiatus hernia with free reflux. The hernia is not self reducing. Above the dome of the hernia there appears to be a large ulcer crater associated with some narrowing of the oesophagus.

OEESOPHAGOSCOPY

The proximal oesophagus was empty and its mucosa was normal. At 26 cms. from the upper alveolus there was a normal transition from oesophageal to gastric mucosa. At 38 cms. there was a granular appearance on the posterior wall. It is possible that this was an inflammatory lesion closely related to an ulcer but no ulcer was recognised. The conclusion being that there is no ulcer of squamous mucosa but it seems most probable that there is a "juxta-cardiac ulcer of the stomach".

OPERATION - Extract from operation notes

Standard left thoracotomy. There was a quite small hiatus hernia. The oesophagus was now exposed and at the level of the lower vein - it was felt to be thickened and hard. It was decided to proceed to oesophagectomy. The oesophagus was divided. Oesophago-gastrostomy was performed.

PATHOLOGICAL REPORT ON RESECTED SPECIMEN

It appears to be a narrow strip of "stomach" bearing at one end a deep chronic ulcer. Histology of the ulcer shows a healing fibrous base bordered by distorted cardiac type gastric mucosa. The appearances are those of chronic gastric ulcer.

PROGRESS

Four years after his operation he is entirely asymptomatic and oesophagoscopy and barium meal show normal post-operative appearances.

COMMENT

Endoscopically the transition from oesophageal to

gastric mucosa is shown to be above the left main bronchus level and well above the gastric dome shown radiographically. At operation the oesophagus above the dome but below the mucosal transition was thickened and hard. This is the site of the penetrating gastric ulcer shown radiographically and confirmed by the pathologist. This is obviously a penetrating ulcer of a segment of oesophagus lined with gastric mucosa and is therefore a Barrett's ulcer. It is noteworthy that the mucosal transition is in no way apparent radiographically.

ILLUSTRATIONS

Case A. W.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and operative findings. The key to the coloured diagram is shown on page 23

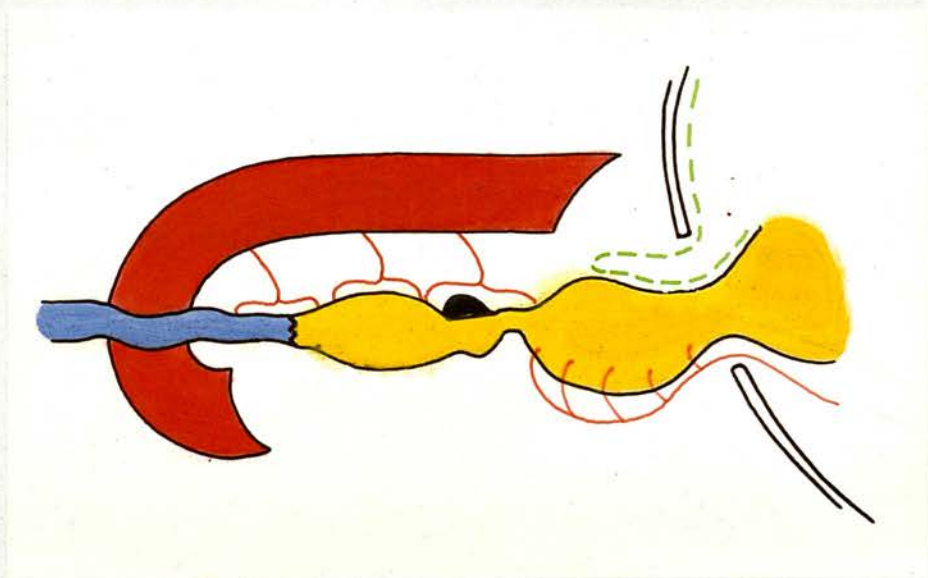
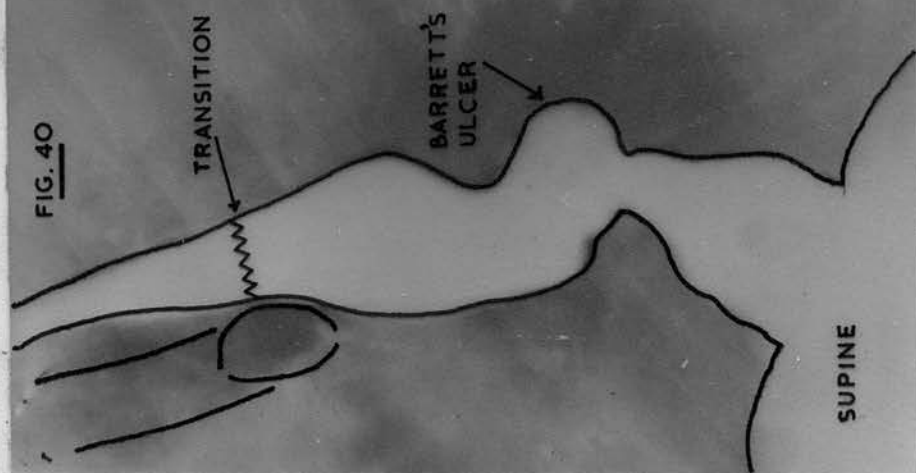
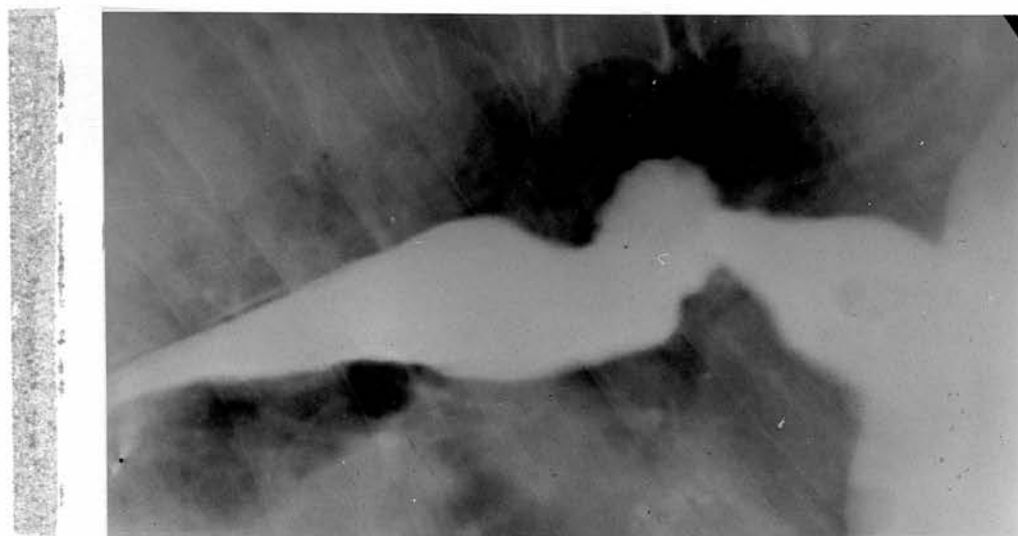


FIG. 41

FIG. 40





CASE - W.T.

Male aged 57

ADMITTED 1956

COMPLAINT

Dysphagia for 5 weeks.

HISTORY

Increasing dysphagia for 5 weeks. Loss of weight (1 stone in 5 weeks). Heartburn and regurgitation for 20 years.

BARIUM MEAL

There is very marked narrowing of the oesophagus 2" below the carina, eccentrically situated. Appearances suggest a carcinoma. The area of narrowing is quite short. Below this the mucosa is of gastric type but although there was free reflux there was no obvious hiatus hernia.

OESOPHAGOSCOPY

Transition at 28 cms. with changes of peptic oesophagitis. There was nodular hard tissue at 31 cms. obstructing the lumen.

BIOPSY

Adenocarcinoma.

OPERATION - Extract from operation notes.

Standard left thoracotomy. There was no evidence of hiatus hernia. It was possible to feel an undoubted tumour of the oesophagus above the level of the lower pulmonary vein. The oesophagus was divided at the level of the aortic arch, the stomach was divided and end to end oesophago-gastrostomy was performed.

DESCRIPTION OF THE RESECTED SPECIMEN

The specimen consists of lower 1 inch of oesophagus and the rest "stomach". There is a hard mass involving the anterior two-thirds of the lower oesophagus and the proximal part of the "stomach".

HISTOLOGY

From mass in oesophagus. This shows inflammation and fibrosis only, no evidence of malignancy. From mass in stomach. This shows adenocarcinoma.

COMMENT

The adenocarcinoma was occurring quite close but below the mucosal transition where there were changes of peptic oesophagitis. The pathology of the two conditions was inter-mingled. In view of the absence of evidence of hiatus hernia radiologically and at operation it would appear that the oesophagus up to the left main bronchus was lined by gastric mucosa and an adenocarcinoma had developed close to the mucosal transition. The mucosa below the tumour had the radiological features of gastric mucosa which could have been helpful in suggesting the diagnosis.

CASE - I.G.

Female aged 57 years

ADMITTED 1957

COMPLAINT

Dysphagia for two years.

HISTORY

Patient complains of gradually increasing dysphagia over the past two years and now is living entirely on semi-solids, scrambled eggs and milk etc. Minced meat gives her trouble and she has stopped trying to eat it. She was admitted to the Royal Northern Infirmary in May of this year. At that time there was no abnormality clinically but X-ray suggested a "congenitally short oesophagus with a small hiatus hernia and possibly some narrowing between oesophagus and stomach". Oesophagoscopy was performed and the lumen appeared to end at 31 cms. Biopsy from the lower end of the oesophagus showed no evidence of neoplasm. She has no abdominal pain, and no vomiting but food is regurgitated after a meal if it happens to be too solid. She has had no heartburn. She has lost some weight during the last two years.

BARIUM MEAL Figs. 42, 43 and 44.

Short oesophagus type hiatus hernia which does not reduce in the erect position. There is narrowing at the lower end of the oesophagus and only minimal regurgitation occurs into the oesophagus in the head-down position. The appearances in the herniated segment of stomach suggest the possibility of the presence of a peptic ulcer just

below the lower end of the oesophagus. Remainder of the stomach and duodenum negative.

OE SOPHAGOSCOPY

At 23 cms. from the upper alveolus there was a normal transition from oesophageal to gastric mucosa. Tissue was taken from 23 cms. and from 27 cms. for histology. At 36 cms. there was a stricture but no visible ulcer. The stricture which gripped a No.15E bougie and was dilated to 28E. Tissue was taken at 36 cms. for histology.

BIOPSY

- 23 cms. small fragments of squamous mucosa.
- 27 cms. a small portion of gastric mucosa.
- 36 cms. a small portion of gastric mucosa.

PROGRESS

This patient was treated by dilatation only and she has not been seen in the Thoracic Unit since but her doctor tells us that up to three years after the dilatation she remains well and has no difficulty in swallowing.

COMMENT

Correlation of the radiological, oesophagoscopic and histological findings makes it quite clear that this patient has an oesophagus lined from the aortic arch to the hiatus with gastric mucosa. I do not think, in spite of what the radiologist said at the time that she had a sliding hernia because of the difficulty in producing reflux and because I believe that the bell shape above the diaphragm is produced by the stricture rather than by

the expansion of a gastric pouch. The stricture at 36 cms. cannot be due to peptic oesophagitis of squamous mucosa as this ends at 23 cms. and must be due to a Barrett's Ulcer which is easily seen radiologically.

ILLUSTRATIONS

Case I. G.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examinations with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and histological findings. The key to the coloured diagram is shown on page 23

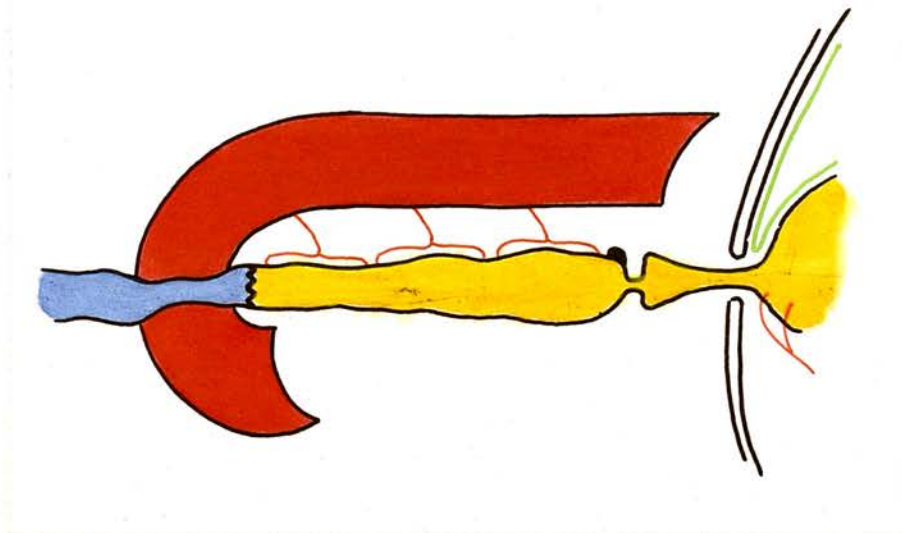
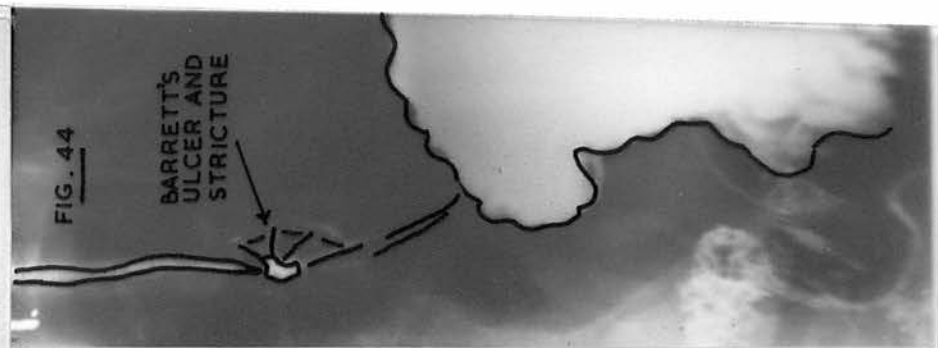
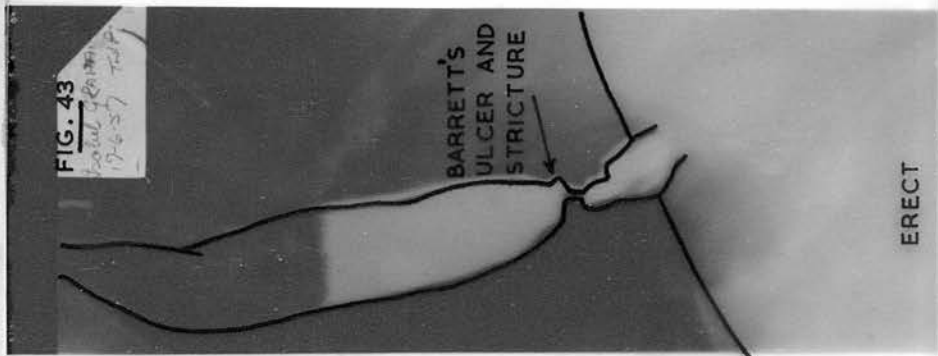
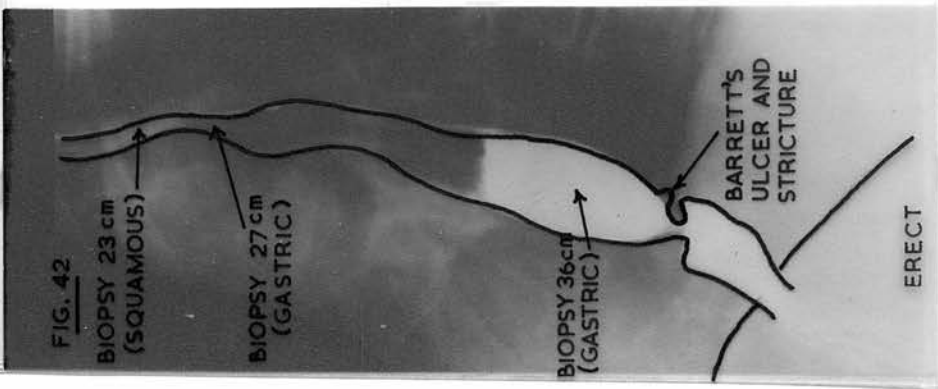
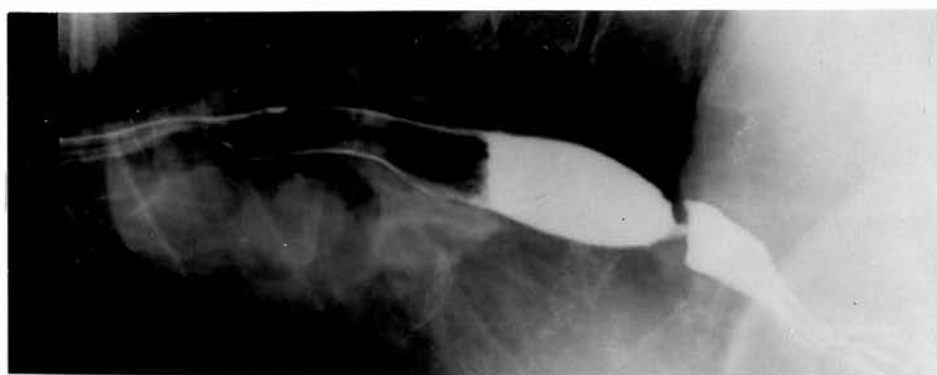
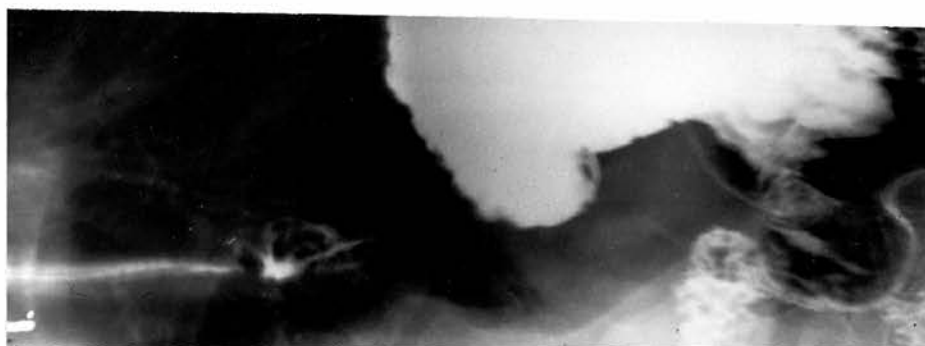


FIG. 45





CASE - E.T.

Female aged 16 years

ADMITTED 1957

COMPLAINTS

Breathlessness on exertion and dysphagia since early childhood.

HISTORY

She has had difficulty in swallowing since early childhood but managed to exist quite well until the age of ten when she ceased to be able to swallow anything at all. She consulted a doctor who gave her a bougie by means of which she dilated her own oesophagus and after dilatation she could swallow anything. She has always been stunted in growth and breathless on exertion and this was considered to be due to congenital aortic valve disease with considerable incompetence.

BARIUM MEAL Fig.46.

Dilatation of the oesophagus down to a level of about two inches below the arch of the aorta. At this level there is a tight, fairly irregular stricture. Regurgitation occurred from the fundus of the stomach into the part below the stricture in the Trendelenburg position and this part appears to be lined with gastric mucosa.

OESOPHAGOSCOPY

The upper oesophagus was normal. At 28cms. a tight round stricture was seen which bled and made vision difficult. No ulceration was seen. A F.14 bougie

entered and was tightly held. No attempt was made to dilate and a loose piece of tissue was removed, for histology.

BIOPSY

The material is inspissated pus membrane from a superficial mucosal ulcer in all probability.

OPERATION - Extract from operation notes.

Standard left thoracotomy. The only abnormality detectable in the chest was the presence of firm enlarged glands both on the oesophagus and lateral to the descending aorta. The stomach, duodenum, gallbladder and pancreas looked and felt normal. It was decided to prepare for gastric replacement of the lower oesophagus. The stomach was mobilised. The peritoneum passed smoothly from the lower surface of the diaphragm on to the stomach without any indication of a hernia. The part of the tube below the stricture was supplied primarily by two transverse branches from the aorta leaving no doubt that the lesion was a congenital one. The fixation of the stenotic oesophagus was less dense than usual and consequently there was some difficulty in recognising the site of stenosis by any other indication than the maximum enlargement of lymphatic glands. The oesophagus was mobilised from the diaphragm to the aortic arch. The stricture was just below the aortic arch. The oesophagus was divided there. End to end oesophago-gastrostomy was performed.

PROGRESS

Normal swallowing after operation and has remained asymptomatic up to three years after the operation though her cardiac state has deteriorated.

PATHOLOGY

Resected specimen.

MACRO.

Lower part of oesophagus and adjacent cardia.

No obvious ulceration on mucosal surface and no obvious fibrosis seen in the cut section.

MICRO.

The oesophageal segment is lined by fibrosed granulation tissue, the squamous epithelium having disappeared. The sub-mucosa is fibrosed in the same segment. The "gastric" end is lined by cardiac-type mucosa and shows no pathological features.

COMMENT

The transition from oesophageal to gastric mucosa is shown endoscopically and by pathological examination of the resected specimen to be just below the aortic arch - the site of the radiographic stricture. The tube below the stricture known to be lined with gastric mucosa looked externally like oesophagus and had an oesophageal blood supply. There was no evidence of herniation of the stomach or of a peritoneal sac. There was no evidence of hernia radiologically but the condition was suggested by the rugose mucosa below the stricture and the fact that strictures from reflux oesophagitis are at the mucosal transition. There is no explanation for the presence of gastro-oesophageal reflux in this case.

ILLUSTRATIONS

Case E. T.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

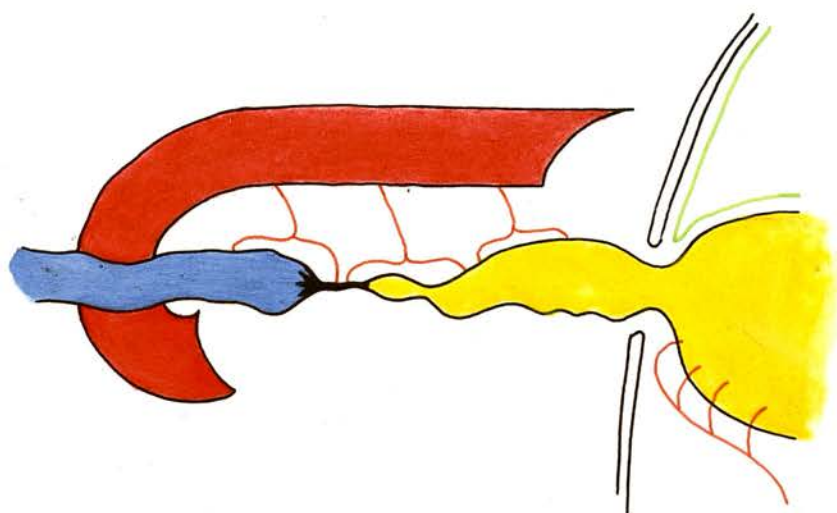
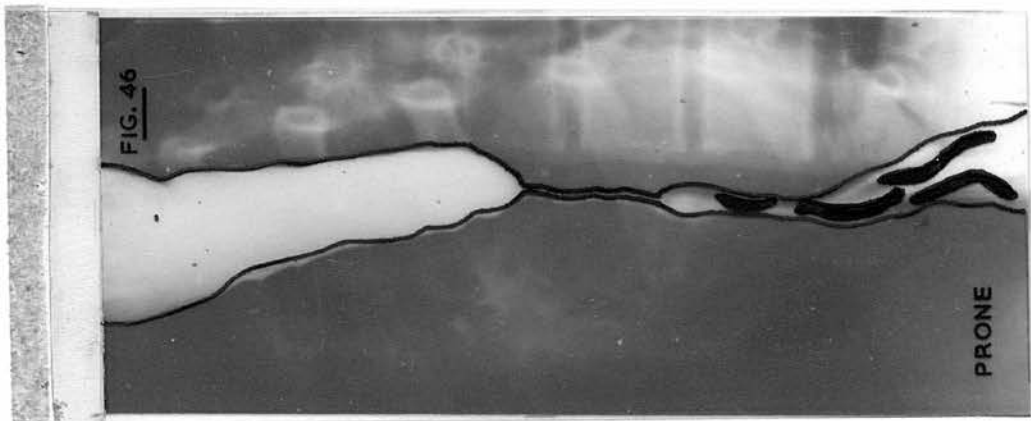


FIG. 47





CASE - E.D.

Female aged 58 years.

ADMITTED 1958COMPLAINTS

Intermittent dysphagia for two years.

HISTORY

Over the last two years she says she has had difficulty in swallowing. On direct questioning she says that at no time in the last six months has she swallowed normally. The difficulty with swallowing varies from day to day but she has not been able to eat a normal meal for the last nine months having to eat food of soft consistency. She has no pain. She sometimes makes herself vomit when a solid piece of food sticks but she does not vomit unintentionally. She has not lost any weight.

BARIUM MEAL Fig.48

There is a short oesophagus type hiatus hernia with free reflux into the gullet. At the level of the carina there is an irregular filling defect in the oesophagus above which reflux occurs freely. Stomach and Duodenum: otherwise negative.

OESOPHAGOSCOPY

At 24 cms. there was typical peptic oesophagitis with an associated stricture which grasped a 16E bougie and was dilated to 25E. A biopsy was taken from the stricture.

BIOPSY

The small portion of tissue in the oesophageal biopsy

is partly covered by squamous epithelium and partly by gastric mucosa. The muscularis is thickened and fibrous and shows chronic inflammation.

PROGRESS

Treated by dilatation and subsequent oesophagoscopy showed a peptic ulcer and stricture still present and immediately beyond the stricture gastric mucosa. One year afterwards she is symptomless following further dilatation, weight reduction, alkalis and avoidance of recumbancy.

COMMENT

Endoscopy shows the transition from oesophageal to gastric mucosa to be at the level of the aortic arch and this is confirmed by biopsy. Between the stricture and the gastric dome of the hiatus hernia is a segment lined with gastric mucosa though this is not directly apparent radiographically. Since the stricture is usually at the mucosal transition and the lower end of the oesophagus is marked by the constriction of the cardiac sphincter mechanism then the fact that a portion of gullet is lined with gastric mucosa may be inferred.

ILLUSTRATIONS

Case E. D.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and histological findings. The key to the coloured diagram is shown on page 23

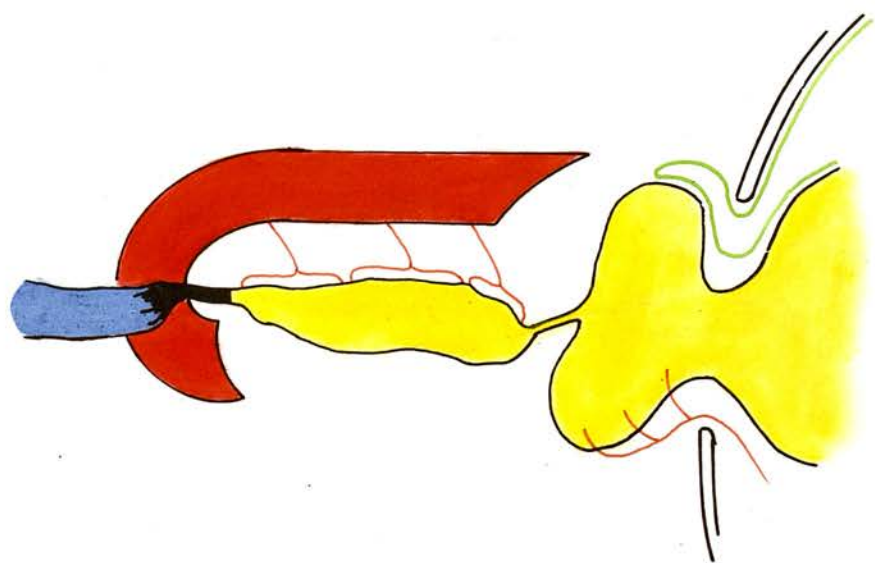
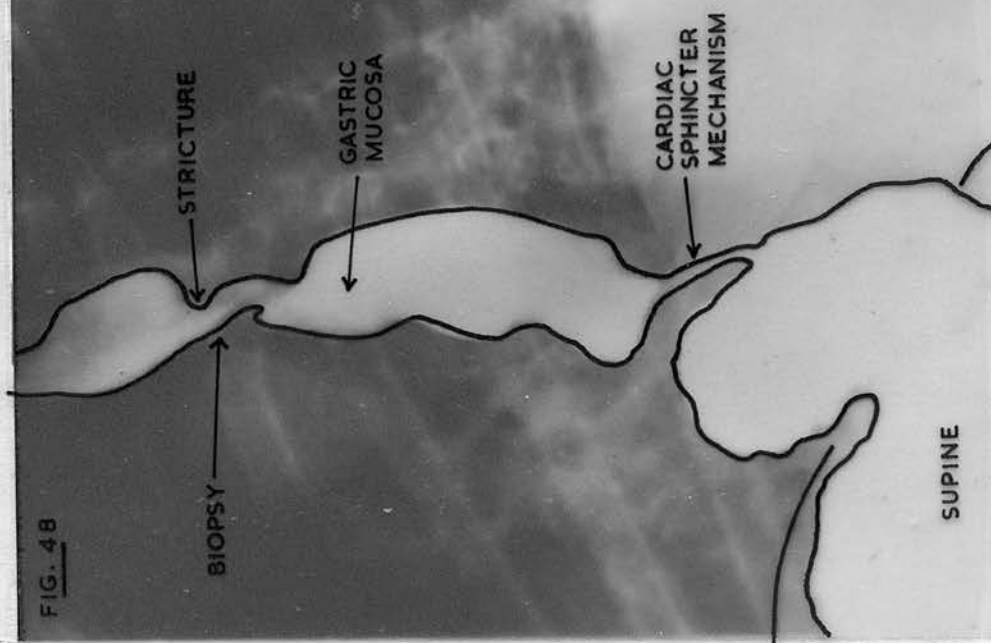


FIG. 49

FIG. 48





CASE - A.S.

Female aged 64 years

ADMITTED 1958COMPLAINTS

Weakness, breathlessness and depression for eighteen months.

HISTORY

She dates all her present complaints from a car accident four years ago. Following this she was a little weak and easily tired but over the last eighteen months these symptoms have become worse. She has become breathless on exertion. She notices ankle swelling occasionally at night. She becomes easily depressed. She was referred to hospital in Fife and found to be anaemic and was given Cytamen and iron pills without much improvement. While in Fife a barium examination was carried out and she was told she had a hiatus hernia. She has had no indigestion, heartburn or dysphagia.

PAST HISTORY

She has a hare lip and a cleft palate.

STOOL BENZIDENE

Negative.

BARIUM MEAL Figs. 50 and 51.

Large paraoesophageal hernia with the stomach upside down in the chest and only the duodenal cap was in the abdomen. The stomach appeared intrinsically normal. There was no reflux into the oesophagus although the gullet is moderately dilated and poorly peristaltic.

OESOPHAGOSCOPY

At 23cms. there was a normal transition from oesophageal to gastric mucosa without evidence of oesophagitis. A portion of tissue was removed just distal to the transition for histology.

BIOPSY

This is a fragment of tissue containing glands of cardiac type and partly covered by a columnar mucus-secreting epithelium. No squamous epithelium is present.

COMMENT

The transition from oesophageal to gastric mucosa is proved endoscopically and by biopsy to be at the level of the aortic arch. Radiographically the gullet distal to the transition appears in no way different from squamous mucosa in the same site. This condition could not have been diagnosed or confirmed radiologically and indeed was only diagnosed, by chance, endoscopically in the investigation of an anaemia which had nothing to do with the gullet. The presence of a para-oesophageal hiatus hernia in addition was a complete bar to reflux.

ILLUSTRATIONS

Case A. S.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examination with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and histological findings. The key to the coloured diagram is shown on page 23

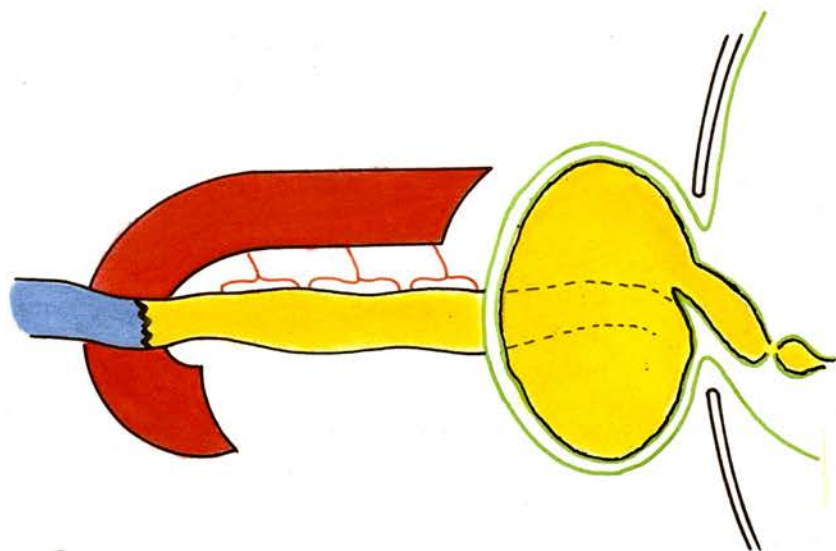
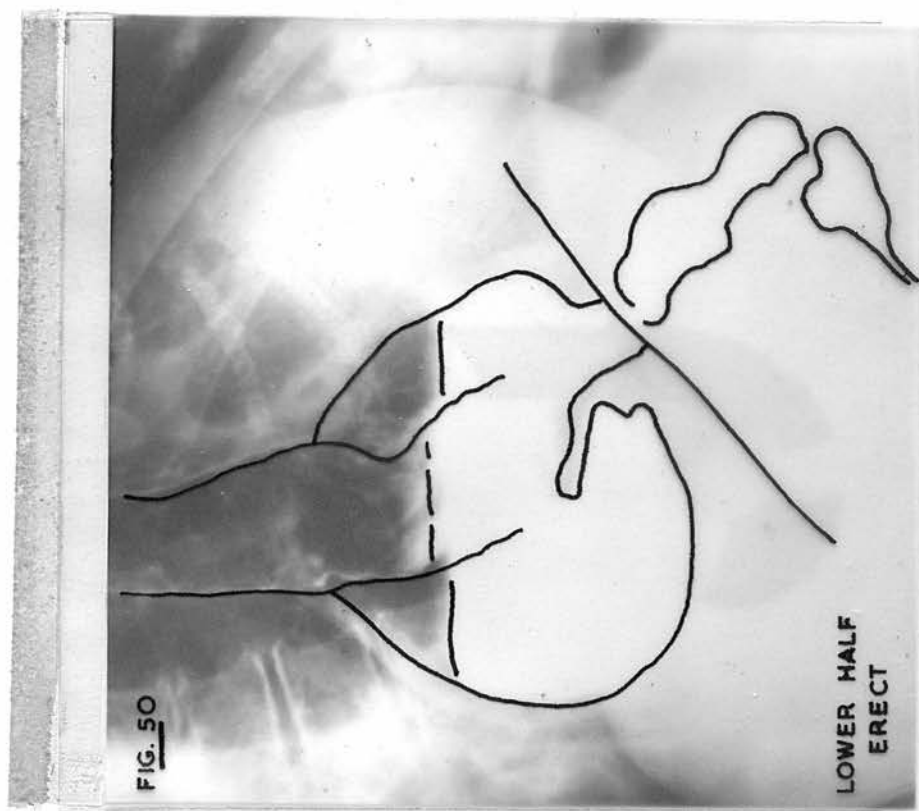


FIG. 51



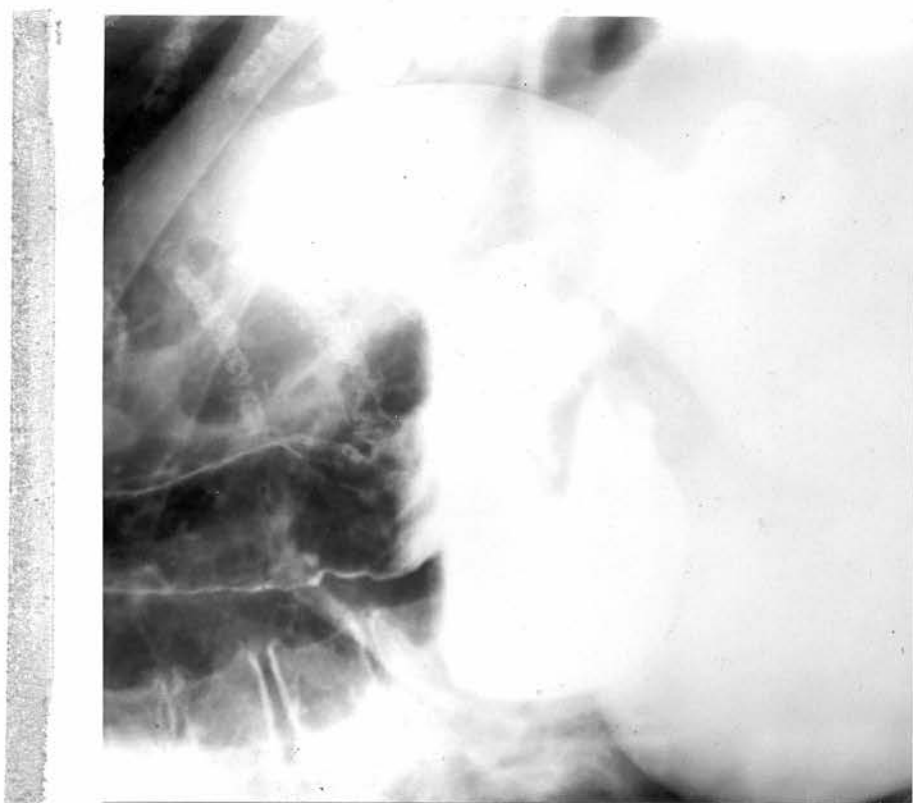
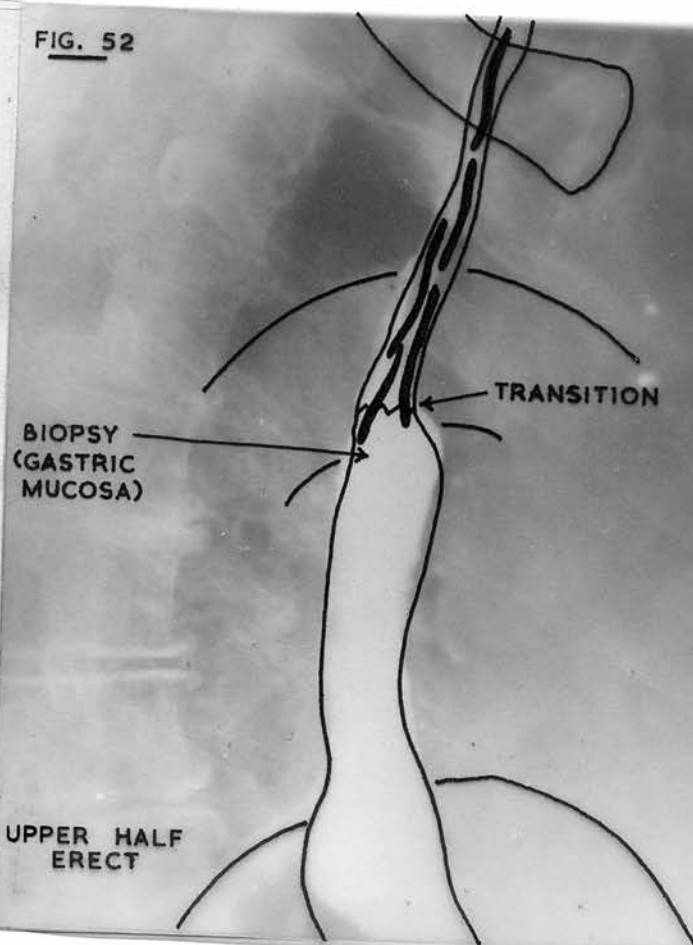
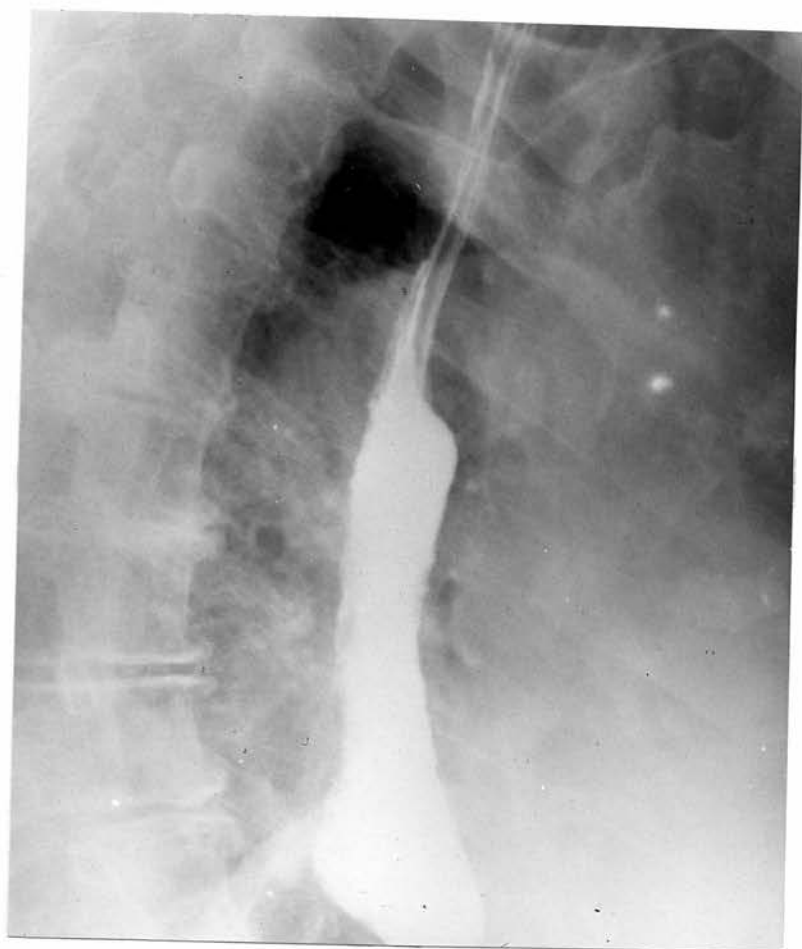


FIG. 52





CASE - D.G.

Female aged 57 years

ADMITTED 1958COMPLAINTS

Epigastric pain, vomiting and regurgitation for six months.

HISTORY

This lady first complained of mid-epigastric pain in February of last year radiating through to the back and associated with occasional vomiting and regurgitation. Because of these symptoms she was admitted to hospital and a barium meal carried out which was said to show a short oesophagus type hiatus hernia. She was also discovered to be anaemic (Hb-46%) and was treated by blood transfusions and iron. She had a high blood urea (150mg/100ml) and on I.V.P. there was no excretion of the contrast medium at the end of 90 minutes.

HISTORY

Nothing of significance and no pregnancies.

BARIUM MEAL Fig.53.

There is a moderate sized hiatus hernia of the short oesophagus type associated with oesophageal reflux in the head-down position. There is no radiological evidence of oesophagitis. The remaining portion of the stomach and the duodenum showed no abnormality.

OESOPHAGOSCOPY

The proximal oesophagus contained a large quantity of clotted blood. When this had been evacuated with

considerable difficulty the transition from oesophageal to gastric mucosa became apparent at 23cms. At this level there were changes of peptic oesophagitis but no stricture formation.

COMMENT

The features of this lady's clinical condition were:- anaemia, purpura, vomiting and albuminurea. It was thought that these features could be explained on a basis of chronic uraemia and in view of this and the hazard of any operative procedure operation was thought to be contra-indicated. The finding of a segment of gullet lined with gastric mucosa was a chance one brought about by the investigation of chronic uraemia. Endoscopically the transition between oesophageal and gastric mucosa was at the level of the aortic arch and although there was peptic oesophagitis there was no stricture. More than half of this patient's gullet was lined with gastric mucosa but this was in no way apparent radiologically nor was the oesophagitis.

ILLUSTRATIONS

Case D. G.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic and oesophagoscopic findings. The key to the coloured diagram is shown on page 23

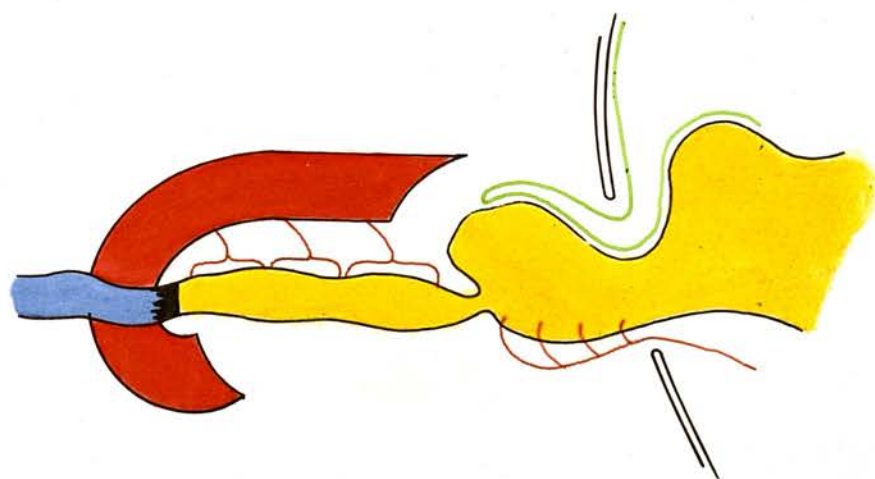


FIG. 54

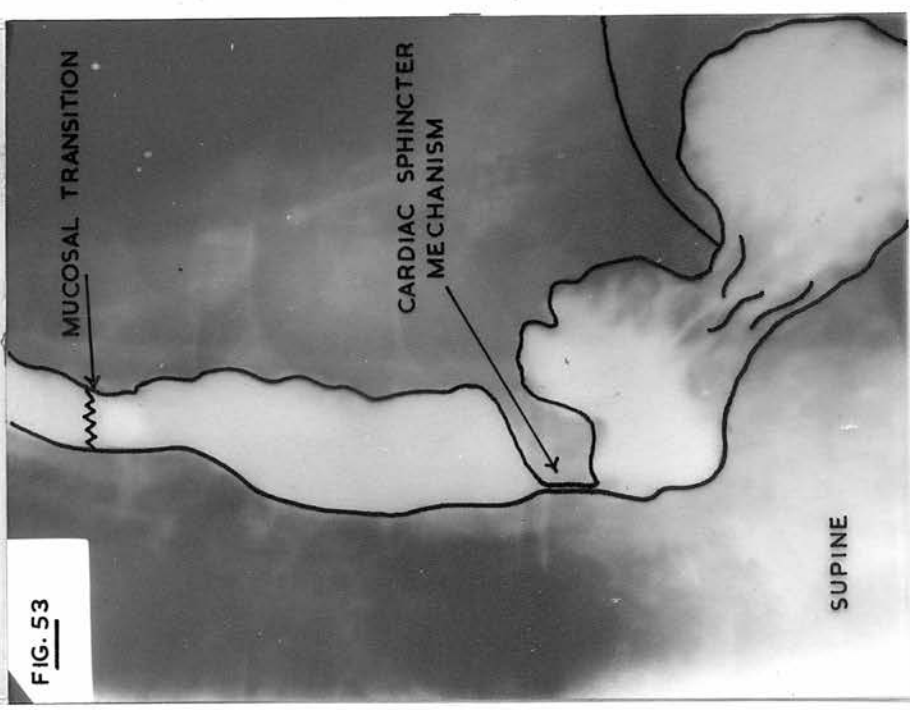
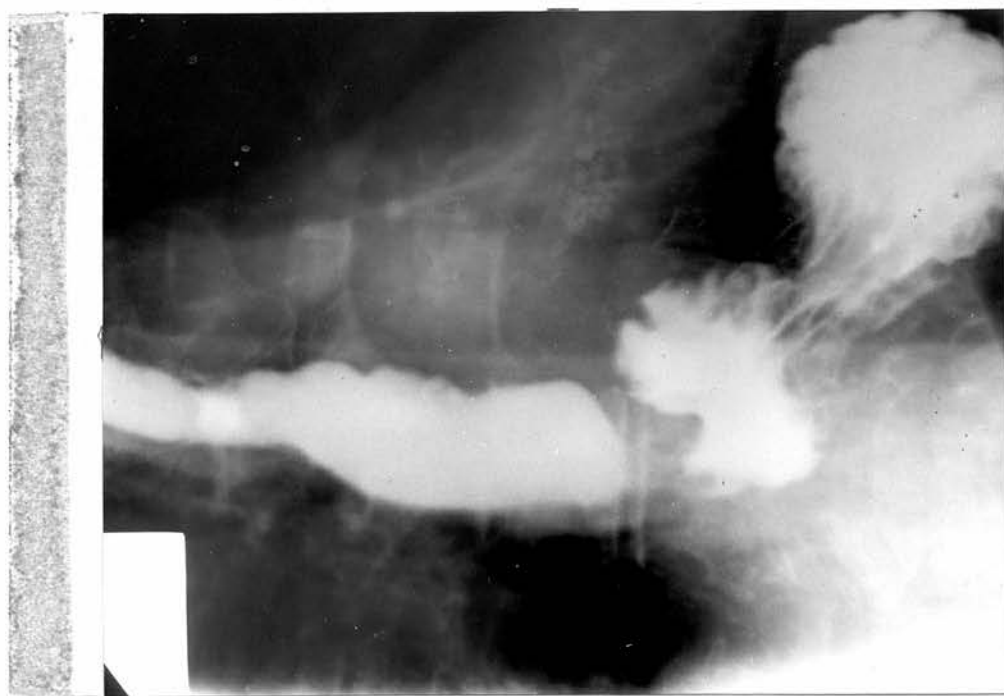


FIG. 53



CASE - E.L.

Female aged 74 years

ADMITTED 1958

COMPLAINTS

1. Indigestion for many years. 2. Acid regurgitation for one year. 3. Dysphagia for three months.

HISTORY

This patient who has suffered from indigestion for many years began to complain of acid regurgitation about one year ago. This acid regurgitation produced a burning sensation in her throat which was worst when lying down. About three months ago she noted the onset of dysphagia with food sticking about the middle of the sternum coming on immediately after swallowing.

BARIUM MEAL Figs. 55 and 56.

There was free gastro-oesophageal reflux and a large gastric dome above the hiatus indicating a sliding hiatus hernia. At the level of the carina there was a stricture and between the stricture and the hernia a long tube that looked like normal gullet and the mucosal pattern showed fine vertical lines in contrast to the mucosa of the hernia which was heavily rugose.

OESOPHAGOSCOPY

Between 23 and 25 cms. from the upper alveolus there were typical changes of peptic oesophagitis and an associated stricture admitting a 15E bougie which was dilated to 24E. Biopsy was taken of the mucosa beyond the stricture.

BIOPSY

This tissue is mucous secreting columnar epithelium.

PROGRESS

She was treated conservatively on account of her age. Two years later she had no dysphagia and could swallow anything but she still had a little regurgitation at night. Oesophagoscopy at that time showed no significant change in her peptic oesophagitis and stricture.

COMMENT

The transition from oesophageal to gastric mucosa is clearly placed at 25 cms. both endoscopically and by biopsy and this level is just above the left main bronchus which is the site of the stricture shown radiographically. Radiographically there are three segments in the chest.

1. Normal oesophagus down to stricture.
2. Apparently normal oesophagus from stricture to hernia.
3. The hernia itself.

There are no radiographic signs indicating that the middle segment is lined with gastric mucosa though this may be inferred from the fact that the stricture usually marks the mucosal transition. At barium examination there was a possible ulcer niche with a persistent barium rest just below the stricture. This may represent a Barrett's ulcer close to the transition and adjacent to the peptic oesophagitis of squamous mucosa.

ILLUSTRATIONS

Case E. L.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examination with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and histological findings. The key to the coloured diagram is shown on page 23

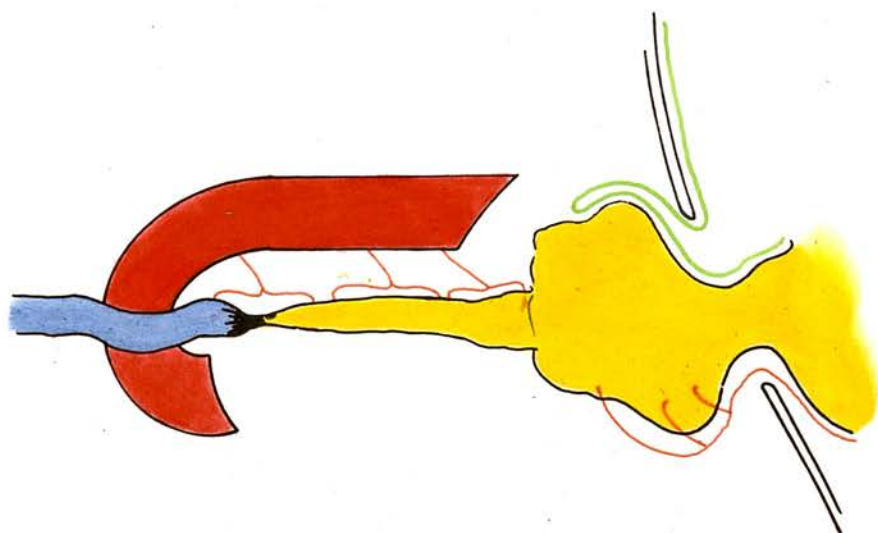
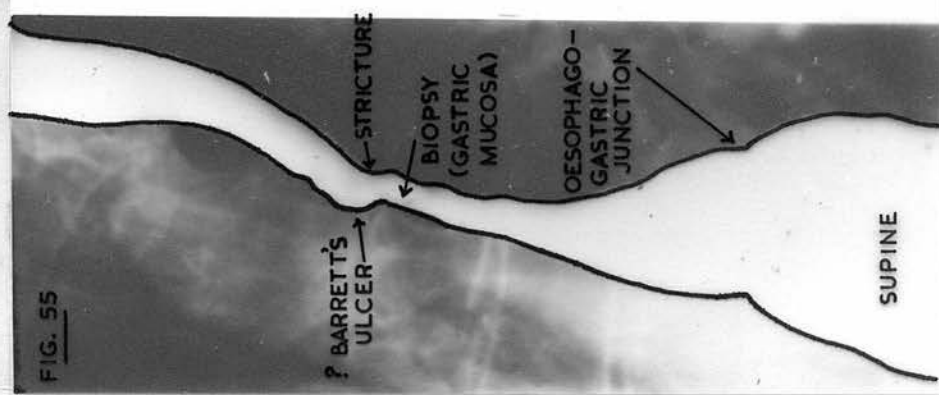
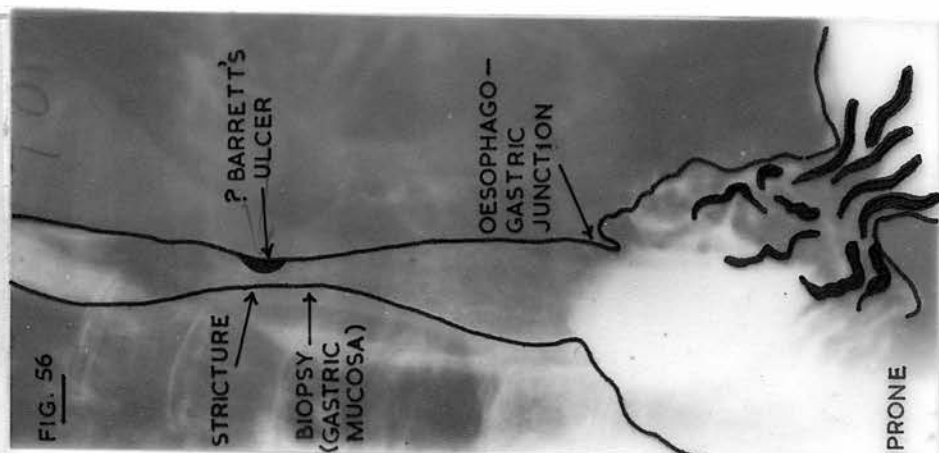
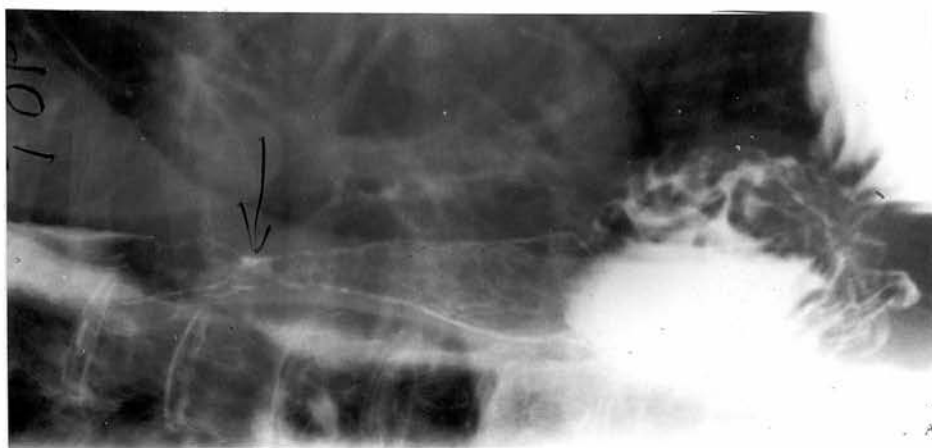


FIG. 57





CASE - E.K.

Female aged 52 years

ADMITTED 1958

COMPLAINTS

Dysphagia for four years. One incident of haematemesis.

HISTORY

This woman was in good health until four years ago when she had an attack of dysphagia followed by vomiting of several ounces of blood. Since then she has had intermittent heartburn, without regurgitation and her dysphagia has persisted, requiring dilatation in 1955 but not again until nine months ago, and since then she has required it on four occasions. Her symptoms are not influenced by stooping or lying down. She has not lost weight.

PAST HISTORY

No trouble with pregnancies and no previous illnesses of note.

BARIUM MEAL Fig. 58.

There is an area of stenosis in the gullet at the level of the aortic arch. The stenosis is smooth and uniform. Above the diaphragm there is a moderate sized hiatus hernia of the short oesophagus type and between the stricture and the hernia is what appears to be a moderately dilated segment of the gullet showing tertiary waves in response to reflux which was considerable. Between this abnormal segment and the hernia is a periodic constriction representing the cardiac sphincter mechanism and indicating the gastro-oesophageal junction.

OESOPHAGOSCOPY

Three oesophagoscopies confirm the presence of peptic oesophagitis beginning at 20 cms. and ending in stricture formation at 22 cms. On one occasion a biopsy was taken from beyond vision for histology.

BIOPSY

Several small fragments consisting of cardiac type gastric mucosa with scanty infiltration of chronic inflammatory cells.

OPERATION - Extract from Operation notes.

Left thoracotomy. The lung was mobilised sufficiently to expose diaphragm and lower mediastinum. The pulmonary ligament was incised. A pouch which looked like stomach was exposed. No further mediastinal dissection was carried out. The oesophageal hiatus admitted four fingers and there was a peritoneal sac about $2\frac{1}{2}$ inches in depth. Stomach and duodenum were normal. The margins of the oesophageal hiatus were defined, the hernia was reduced and what looked like oesophagus brought down below the diaphragm. The hiatus was then narrowed.

PROGRESS

Two months after the operation she feels extremely well and feels better than she has felt for many years. She has had no dysphagia, no regurgitation and no heartburn. Her appetite is excellent and her weight is steadily rising.

POST-OPERATIVE OESOPHAGOSCOPY

Stricture at 23 cms. lightly grasped a No. 20E. bougie and was dilated to 28E. There was no superficial inflammation and no ulceration.

BARIUM MEAL

There was a narrowing at the level of the aortic arch but no hold-up of barium. There was no hiatus hernia but there was gastro-oesophageal reflux.

COMMENT

The transition between oesophageal and gastric mucosa is localised endoscopically and histologically to the level of the aortic arch corresponding to the stricture seen radiographically. Between the stricture and the dome of the hernia is a segment which at operation looks ^{normal} like gullet but is lined with gastric mucosa. Radiologically this segment is in no way distinguishable from gullet and the muscle shows tertiary wave formation. There is a periodic constriction at the lower end clearly differentiating it from stomach and indicating the cardiac sphincter mechanism. The fact that this segment is lined with gastric mucosa is not apparent radiographically but can be inferred from the fact that the stricture usually marks the mucosal transition.

ILLUSTRATIONS

Case E. K.

Overleaf are the illustrations of the preceding case, consisting of a radiograph of the barium examination with a superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

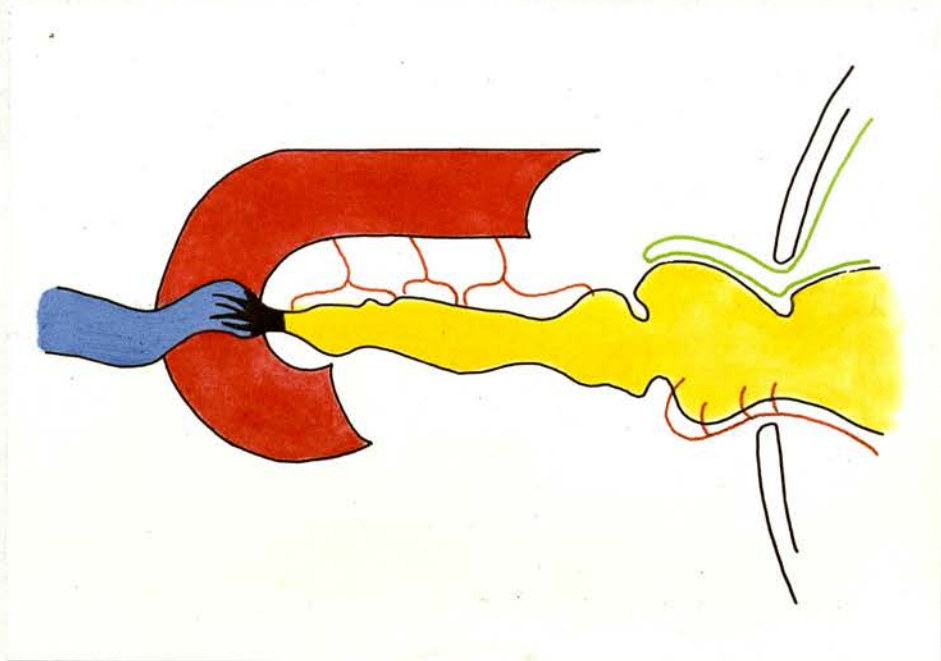
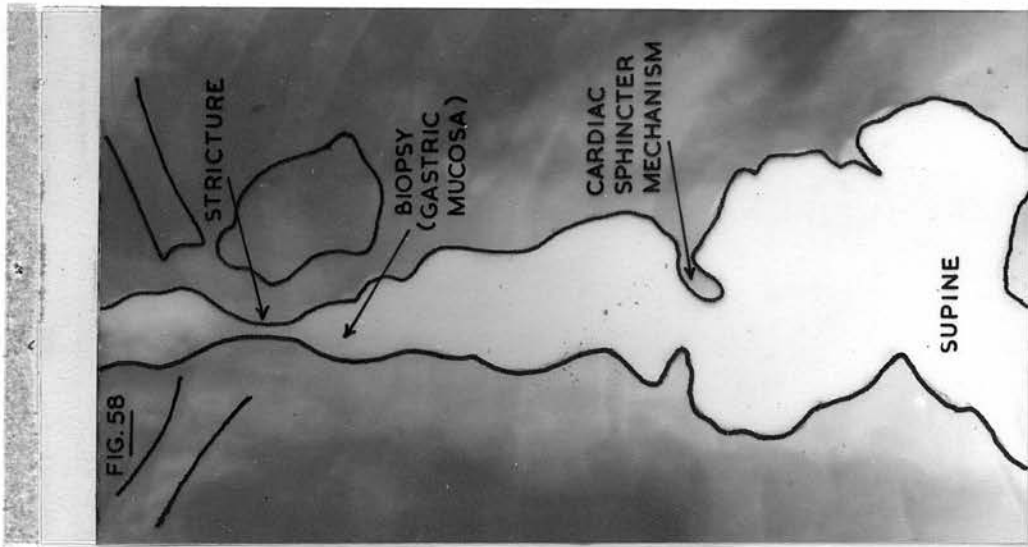


FIG. 59





CASE - M.D.

Female aged 50 years

ADMITTED 1959

COMPLAINTS

- 1) Heartburn and regurgitation for one year.
- 2) Pain over lower end of sternum and dysphagia for solid foods, recently.

HISTORY

This lady had epigastric pain for many years. Over the last year she has been suffering from heartburn, regurgitation and pain over the lower third of the sternum. More recently she has had difficulty in swallowing solid foods. On questioning she says that she cannot do her housework since her regurgitation becomes worse on bending. All her symptoms become worse on lying down especially at night. About one month ago she noticed that her stools were black in colour (unfortunately the result of a Benzidine Test done at that time is unknown).

PAST HISTORY

Appendicectomy at the age of 14.

BARIUM MEAL Figs. 60 and 61.

There is a short oesophagus type hiatus hernia with reflux. Persistent narrowing at the "cardia" indicates a stricture. Stomach otherwise negative. Duodenum: there was some hold-up at the pylorus and persistent deformity of the cap. No definite ulcer crater was seen.

OESOPHAGOSCOPY

Peptic oesophagitis at 32cms. with stricture. No biopsy taken.

OPERATION - Extract from operation notes

Standard left thoracotomy. Rubbery glands were felt along the aorta at the lower pulmonary vein level. Careful inspection of the region of the hiatus without manipulation of the viscera showed no peritoneal sac. On the other hand it was possible to introduce three fingers into the mediastinum through the hiatus by invaginating the anterior gastric wall. The stomach, pylorus, duodenum and gall-bladder all looked and felt normal. First the lower oesophagus was dissected off the mediastinum. The sclerosis consequent upon ulceration was best felt at the level of the lower pulmonary vein. The lowest aortic oesophageal branch originated at the level of the lower pulmonary vein and was directed sharply distally towards the stomach. After dissection, the dome of herniated stomach was clearly visible in the lower mediastinum but there was a tube between the gastric dome and the stricture about 3cms. in length. It was certainly not possible to reduce the stricture below the diaphragm. As much of the stomach was delivered below the diaphragm as would easily come. The hiatus was narrowed, both vagi cut, and a gastro-enterostomy performed.

PROGRESS

Since the operation she has been much improved but still has some dysphagia for solid foods. She has occasional bouts of more severe dysphagia when even fluids are regurgitated. She has had no melaena.

COMMENT

On reviewing the barium films the tube between the

gastric dome and the stricture is apparent and in this tube the mucosa has a rugose appearance more typical of stomach than oesophagus. From the operation notes it would appear that this tube is supplied directly from the aorta by a short arterial twig. There was no obvious peritoneal sac but it was possible to make one by invaginating the anterior gastric wall indicating that the sac might be self-reducing. The prevention of reflux by repair of the hernia caused healing of the superficial manifestations of oesophagitis (ulceration and redness) but the stricture was not completely reversible presumably on account of fibrosis.

ILLUSTRATIONS

Case M. D.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examination with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic and operative findings. The key to the coloured diagram is shown on page 23

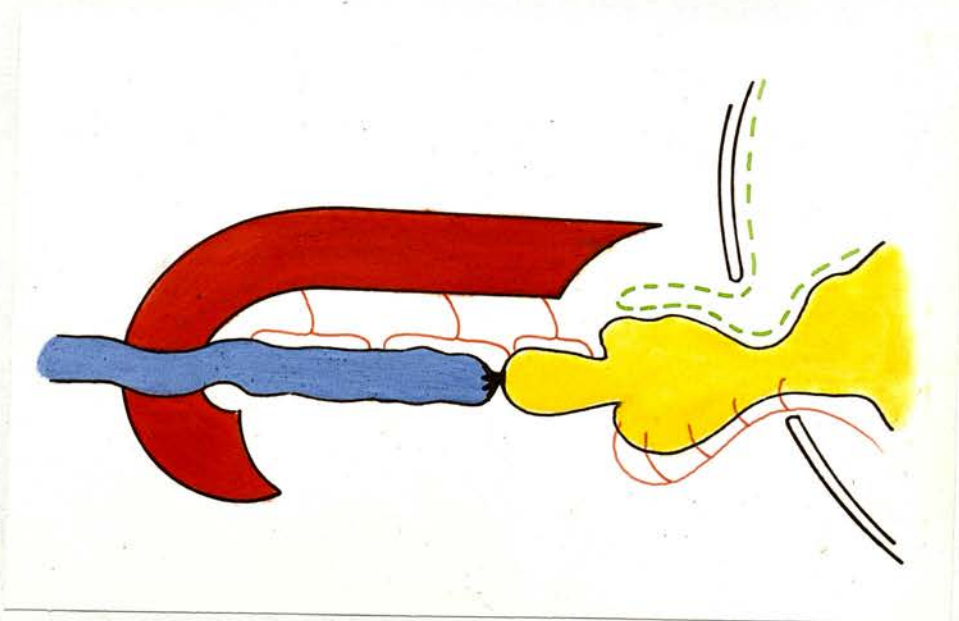
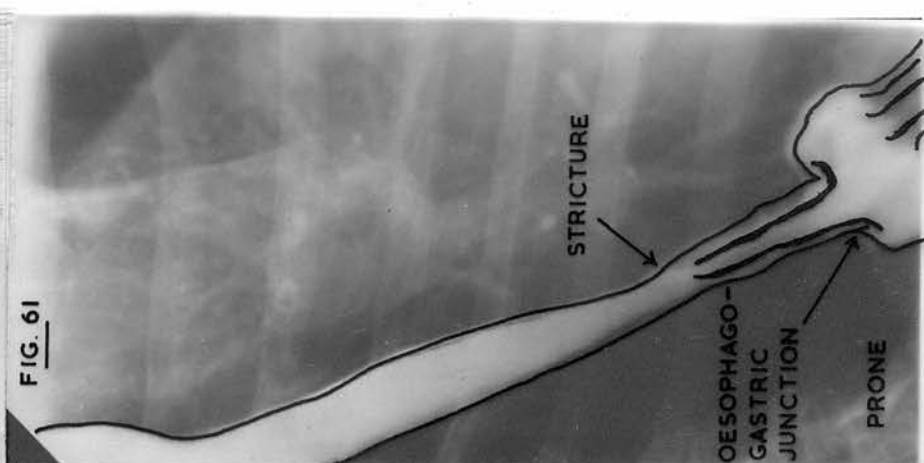
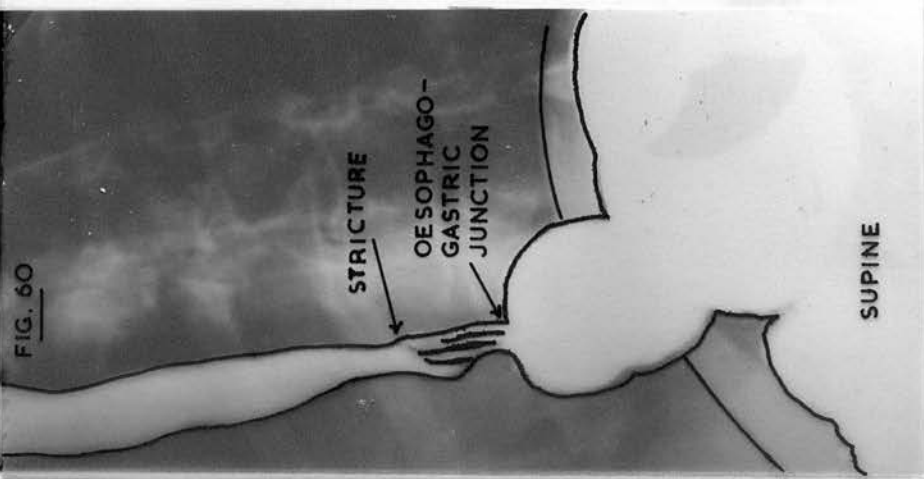
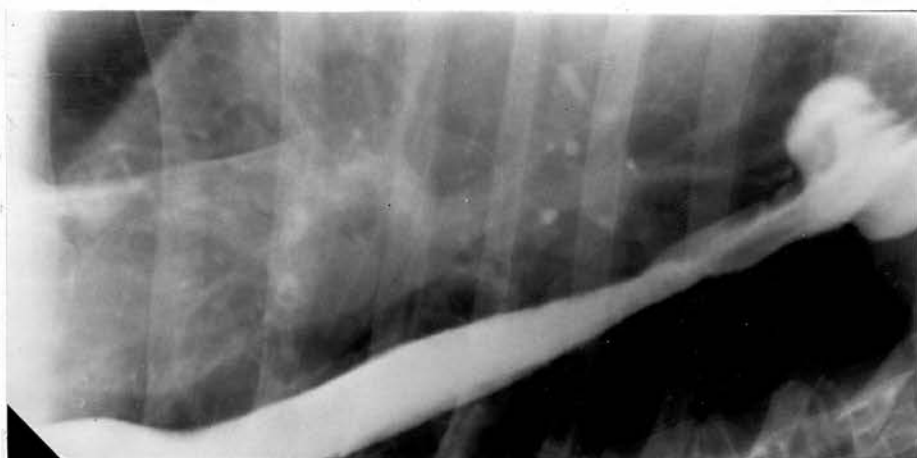


FIG. 62





CASE - V.B.

Female aged 71 years

ADMITTED 1960

COMPLAINTS

Dysphagia for one year.

HISTORY

Poor historian. She has had difficulty in swallowing becoming severe in the last two months. Recently she has had trouble with regurgitation or vomiting. She has lost about two stones in weight since the onset of symptoms.

BARIUM MEAL Fig. 63.

Short oesophagus type hiatus hernia with reflux. Oesophagus above the hernia contains a large filling defect which is typical of an extensive carcinoma. The carcinoma appears to extend upwards to the left main bronchus level, and above this the gullet is dilated with considerable hold-up of barium. Probably an adeno-carcinoma complicating a hiatus hernia.

OESOPHAGOSCOPY

The proximal oesophagus was normal and empty. At 21cms. there appeared to be a normal transition from oesophageal to gastric mucosa but with no evidence of oesophagitis. At 30cms. there was a stricture. The stricture was easily dilated and what was thought to be a tumour became apparent. Biopsy was taken proximal to the tumour and from the tumour itself.

BIOPSY

Proximal to the tumour. These fragments consist of glandular cardiac type mucosa.

From the tumour. Very well differentiated adenopapillary tumour which the pathologist felt sure was malignant.

OPERATION

Standard left thoracotomy. Below the azygos vein the oesophagus bulged for one and a half inches and this bulge ended abruptly at the level of the left main bronchus. From the level of the lower pulmonary vein downwards there was the bulge of the hiatus hernia. The tumour occupied the interval between the two bulges and was densely adherent to the left main bronchus and to the aorta within its sheath. The tumour was considered to be inoperable.

COMMENT

Oesophagoscopically the mucosal transition is at the upper level of the aortic arch and below this the gullet is lined with gastric mucosa down to the adenocarcinoma at the level of the left main bronchus which involves the oesophagus down to the dome of the sliding hernia whose upper limit is at the level of the lower pulmonary vein. The diagnosis could not have been made radiologically since the level of the mucosal transition is not apparent.

Case V.E.

Overleaf are the illustrations of the preceding case consisting of a radiograph of the barium examination with superimposed line drawing for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

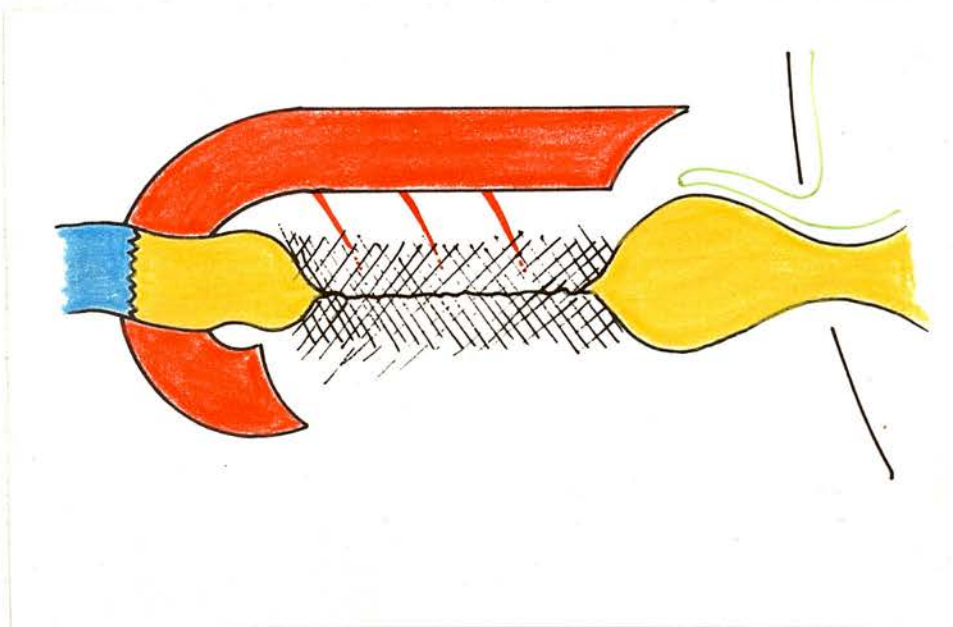
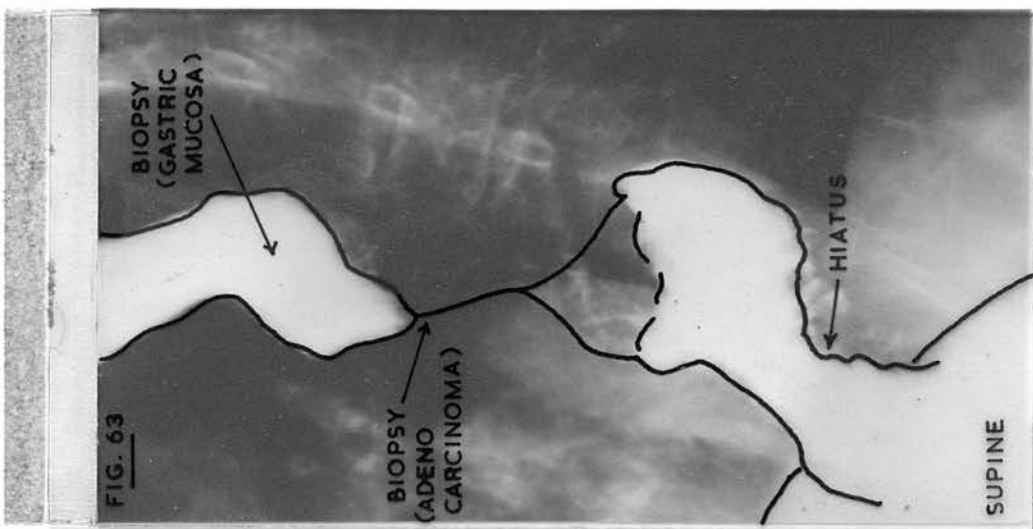
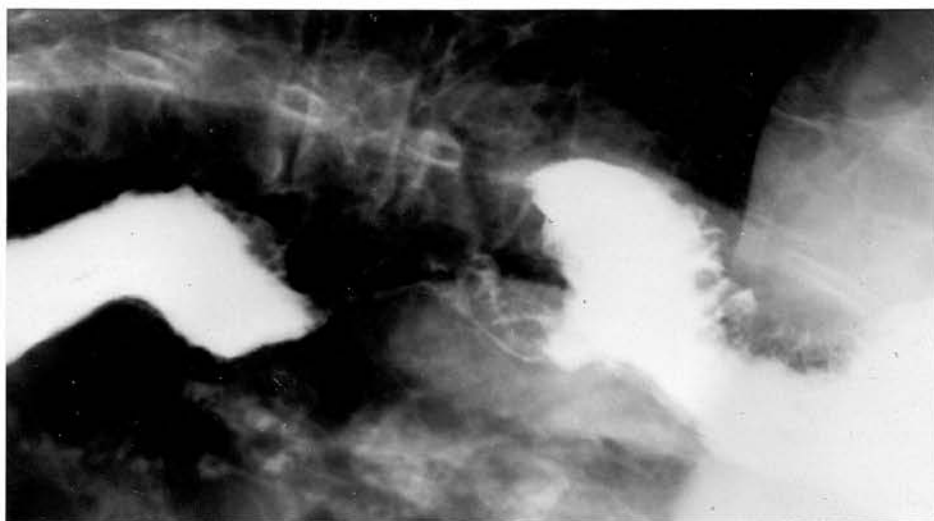


FIG. 64





CASE - C.J.

Female aged 66 years

ADMITTED 1960

COMPLAINTS

Difficulty in swallowing for six months.

HISTORY

This patient has been having difficulty in swallowing solid food for six months and she feels it sticking in her chest. When she lies down she regurgitates sour acid tasting fluid. She has lost nearly a stone in weight in the last six months.

PAST HISTORY

Seven years ago she had a back injury and lay on her back for four months. Subsequently she had "indigestion" and a barium examination showed hiatus hernia.

BIARIUM MEAL Figs. 65 and 66.

Short oesophagus type hiatus hernia with free gastro-oesophageal reflux. In addition there was a persistent narrowing at the level of the arch of the aorta. Otherwise stomach and duodenum negative.

OESOPHAGOSCOPY

From 18 to 20cms. from the upper alveolus there were signs of typical peptic oesophagitis ending in a soft stricture. The stricture was dilated to 22E. without difficulty although initially it grasped a 16E. bougie. Biopsies were taken from 27, 33 and 37cms.

BIOPSY Fig. 68.

(1) 37cms. (2) 33cms. (3) 27cms.

All three specimens consist of typical gastric cardiac mucosa, short tubular crypts and coiled tubuloracemose gland acini. No acid secreting cells seen in sections stained by special methods.

OPERATION - Extract from operation notes.

Standard left thoracotomy. The dome of the stomach visible radiographically with its associated fat was immediately seen in the pulmonary ligament. Dissection at the level of the lower pulmonary vein showed the lowest aortic branches to the oesophagus running slightly distally from the aorta to the oesophagus nearly two inches proximal to the summit of the dome. When the abdomen was inspected without displacement of the viscera other than diaphragm, a peritoneal sac one to one and a half inches deep was seen and felt anterior to the stomach in the hiatus oesophageus. The stomach, pylorus and duodenum were otherwise normal. The gallbladder and pancreas were seen and felt to be normal. The hernia was easily displaced downwards until the dome and an inch of the tubular gullet were in the abdomen. The hiatus was narrowed.

PROGRESS

She has complete relief of symptoms post-operatively.

BARIUM EXAMINATION

Showed no reflux, no hernia and no stricture.

POST-OPERATIVE OESOPHAGOSCOPY

Normal transition at 20cms. with no evidence of oesophagitis or stricture.

COMMENT

Transition from oesophageal to gastric mucosa is

shown endoscopically to be above the aortic arch and this observation was confirmed by biopsy. At operation the segment between the stricture and the hernia looked externally like normal oesophagus and had an oesophageal blood supply. The site of the transition is marked by a stricture shown radiographically. The gullet from the stricture downwards is lined with gastric mucosa but this is not manifest radiographically but can be inferred from the fact that the stricture usually marks the mucosal transition and the lower end of the gullet is clearly shown by the constriction of the cardiac sphincter mechanism.

Three biopsies from the pre-fixed mucosa showed no acid secreting cells and it was assumed that the oesophagitis was due to reflux from the stomach. This was confirmed at operation when repair of the hernia with cessation of reflux caused resolution of the oesophagitis and disappearance of the stricture.

ILLUSTRATIONS

Case C. J.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examinations with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

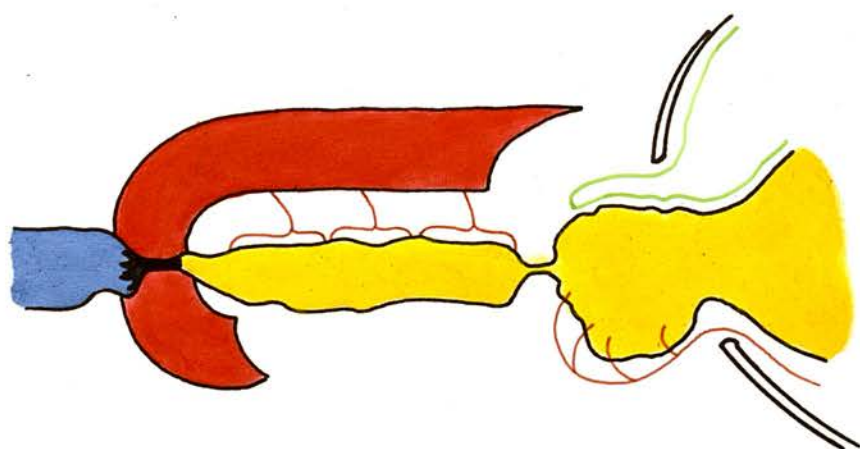


FIG. 67

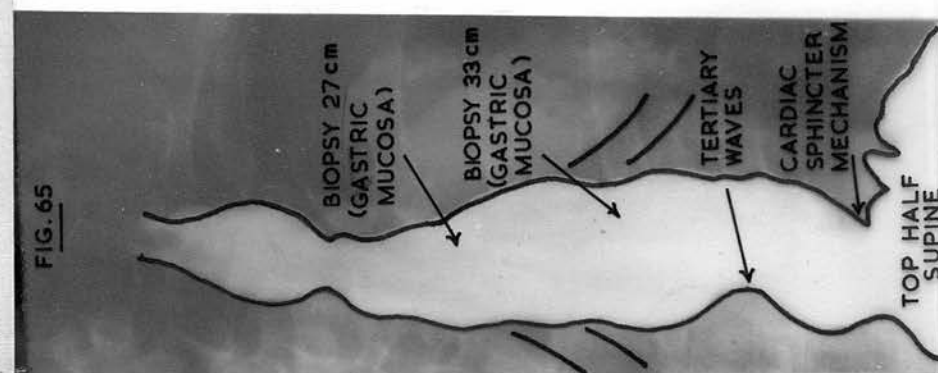
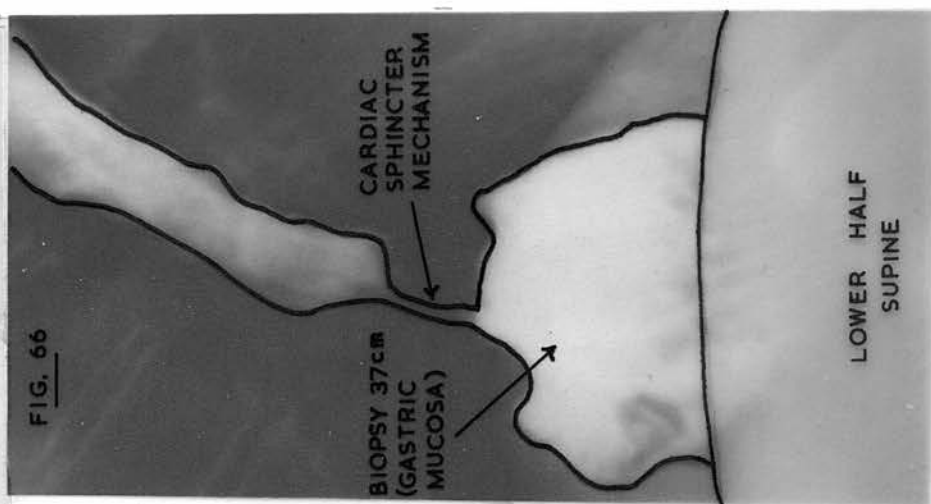






Fig.68

Representive section stained H.&E. of the mucosa lining the gullet, showing typical gastric cardiac mucosa, short tubular crypts and coiled tubulo-racemose gland acini. No acid secreting cells seen in sections stained by special method.

CASE - J.K.

Female aged 57 years

ADMITTED 1960

COMPLAINTS

Vomiting - 26 years, Dysphagia - 6 years.

HISTORY

Since 1934 this patient has had attacks of vomiting on and off about once every three weeks. This vomiting is not accompanied by abdominal pain nor related to meals. It occurs chiefly on waking in the morning and does not seem to have bothered her very much. During the last six years she has had some dysphagia especially with dry food. She describes it as a choking feeling in her chest soon after swallowing food and also accompanied by some pain which radiates up along the left side of her cheek and on the left side of her scalp. She also has some regurgitation which is worse on stooping and a burning sensation at the back of her throat. She finds it easier to eat small quantities at a time.

BARIUM MEAL Figs. 69 and 71.

Short oesophagus type hiatus hernia. There is a fairly long groove at the expected site of the cardia but this dilated up freely and is obviously the site of the cardiac sphincter mechanism. In other respects the stomach and duodenum are normal.

OESOPHAGOSCOPY

The proximal part of the oesophagus contained white froth. At 22 cm. from the upper alveolus there was a

normal looking transition from oesophageal to gastric mucosa making a characteristic spiked line. The gastric mucosa looked normal to 40 cms. Tissue for histological examination was taken from 23 cms. and at 36 cms.

BIOPSY

Biopsy at 23 cms: Normal cardiac type gastric mucosa.

Biopsy at 36 cms: Normal cardiac type gastric mucosa.

OPERATION

Standard left thoracotomy. No abnormality was seen in the lung or mediastinum. The lowest artery supplying the oesophagus lay at the level of the lower pulmonary vein and passed directly to the oesophagus, that is it supplied the tube lined with gastric mucosa. At the first inspection of the abdomen care was taken not to disturb the relations at the hiatus oesophageus. There was no hernial sac. The peritoneum passed tightly from the inner aspect of the diaphragm on to stomach. When an attempt was made to create a pouch in the hiatus by displacing the fat into the mediastinum it could only be made at the expense of the anterior gastric wall. An attempt was made to create a hernia by traction on the oesophagus in the mediastinum. This did not displace the hernial fat or any part of the sub-phrenic stomach and did not give any indication of a peritoneal sac. Stomach, duodenum and gall-bladder were normal. Although no hernia could be produced by any of the manoeuvres described the hiatus felt wide and would readily admit three fingers invaginating the anterior gastric wall.

The absence of any dilatation of the "gastric tube" above the diaphragm was noted. The whole supra-phrenic tube was in no way distinguishable externally from normal oesophagus. In spite of its length the hiatal walls lay in close apposition and it was easy to narrow it with sutures.

PROGRESS

Post-operatively she had no alimentary symptoms but it is too soon to assess the results of the operation.

COMMENT

Endoscopically the transition from oesophageal to gastric mucosa is at the level of the aortic arch and this is proved by biopsy. The tube downwards from there is lined with gastric mucosa though at operation it is identical to normal oesophagus from the outside and it has an oesophageal blood supply. This segment of gullet radiographically appears entirely normal and numerous radiographs show the fine vertical lines characteristic of normal oesophageal mucosa and there is no indication of a high transition. Radiographically the gullet ends inferiorly in a constriction representing the cardiac sphincter mechanism separating it from a small gastric hernia which was not apparent at operation. The conclusion being that either there was a short sacless portion of stomach in the chest or else the hernia was self-reducing.

ILLUSTRATIONS

Case J. K.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examination with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

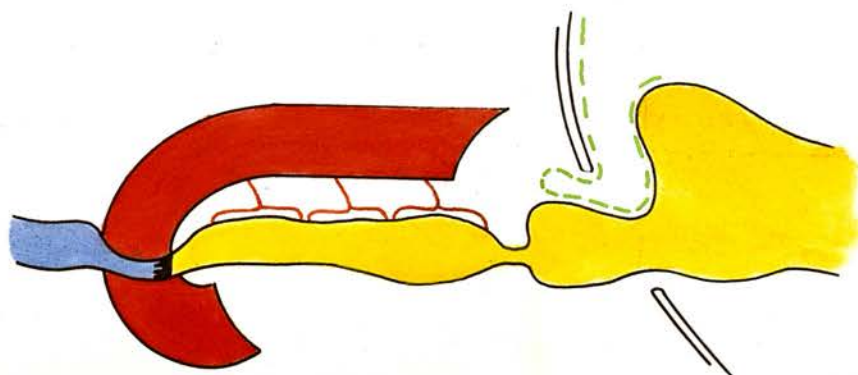
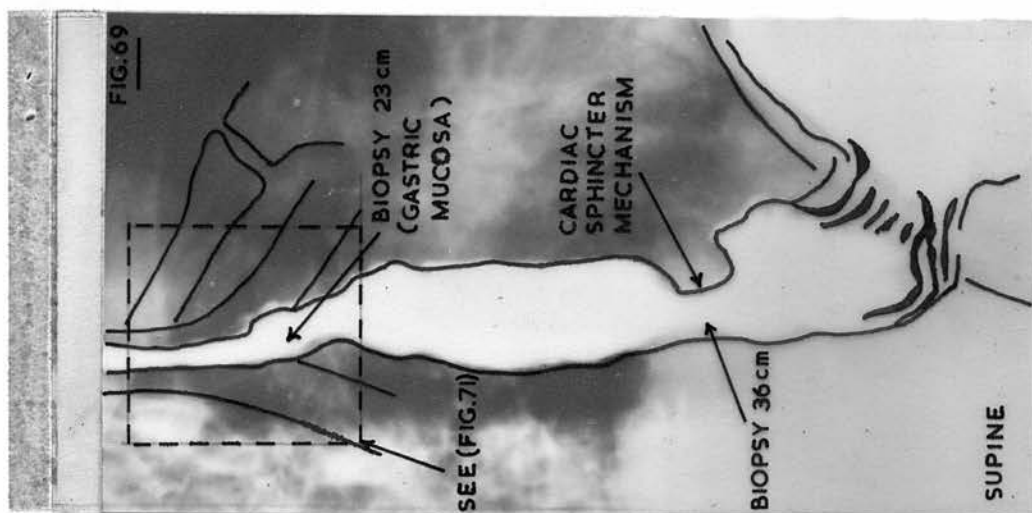


FIG. 70



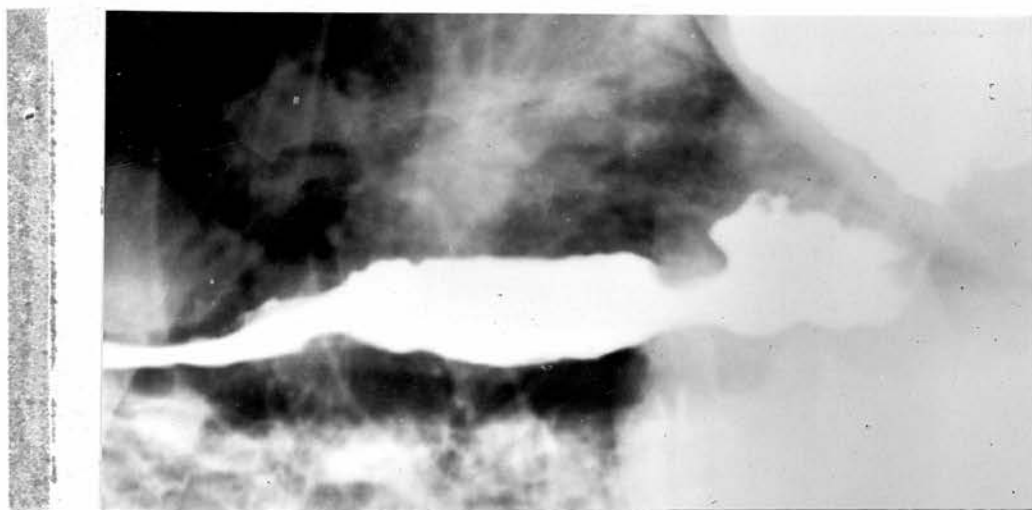
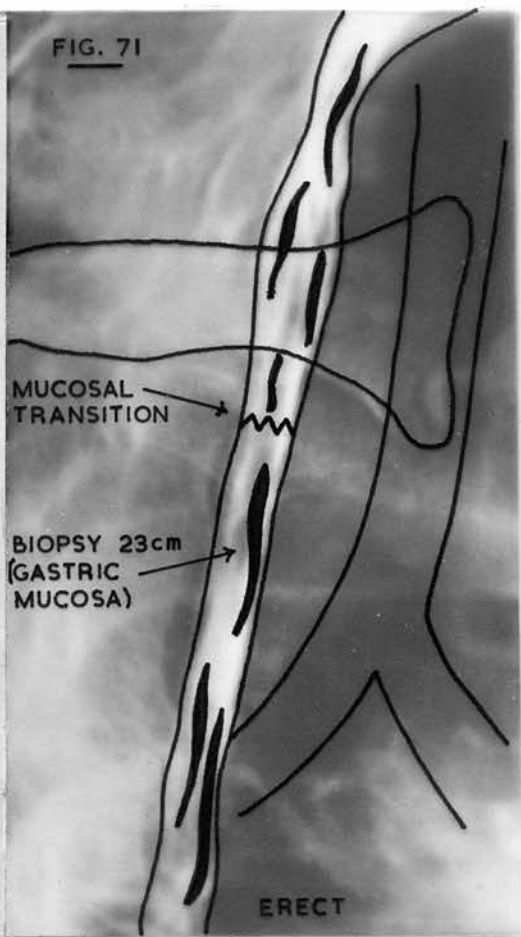


FIG. 71





CASE - J.S.

Female aged 60 years

ADMITTED 1960

COMPLAINTS

Regurgitation for 20 years. Heartburn and dysphagia for 5 years.

HISTORY

For nearly 20 years this patient has been aware that on stooping she had regurgitation of material with an acid taste. During this period she also has had occasional heartburn. Five years ago she began to experience dysphagia occasionally. Food appeared to stick high-up behind her sternum following which it would be regurgitated. This symptom became more frequent until a year ago it happened after every meal. During this period she lost a great deal of weight coming down from 13 stone to 10 stone.

PAST HISTORY

Blood poisoning 20 years ago. Myocardial insufficiency following a bout of influenza ten years ago. Gross bilateral varicose veins have curtailed her activity recently.

BARIUM MEAL Figs. 72, 73 and 75.

There was free gastro-oesophageal reflux. There was a moderate sized hiatus hernia present. Just above the aortic arch was a purse string-like stricture with some hold-up to the flow of thin barium. Between the stricture and the hernia there was a long segment of apparently normal gullet and between this segment and the hernia there

was the periodic constriction due to the sphincter mechanism indicating the gastro-oesophageal junction.

OESOPHAGOSCOPY

Between 17 and 20 cms. from the upper alveolus there were the typical changes of peptic oesophagitis and an associated stricture which grasped a 14E bougie. It was dilated to 25E. The oesophagoscope could not be passed through the stricture and a bronchoscope was passed beyond the stricture and biopsy was taken at 27 cms.

BIOPSY

Gastric mucosa. Some of the glands contain oxyntic cells but they are not well preserved and do not stain well. Normal gastric mucosa of fundic type. Special stains confirm the presence of oxyntic cells. Fig. 77.

OPERATION - Extract from operation notes.

Left thoracotomy. The oesophagus was exposed in the mediastinum and the bulge of a hiatus hernia became apparent. Above the bulge of stomach the oesophagus looked normal but the arteries were not dissected out. The diaphragm was detached from the costal margin. The oesophageal hiatus admitted 4 fingers and there was a peritoneal sac $2\frac{1}{2}$ " in depth in front of the hernia. The rest of the stomach felt normal. The hernia was reduced and hiatus repaired.

PROGRESS

Five months after the operation she is asymptomatic with none of her pre-operative symptoms. Post-operative Barium Meal showed no hiatus hernia and no reflux. The stricture above the aortic arch was barely apparent. Fig. 76.

COMMENT

The transition from oesophageal to gastric mucosa is shown endoscopically and by biopsy to be above the aortic arch, the site of the radiological stricture. At operation between the stricture and the sliding hernia was a large segment which appeared identical to normal oesophagus but was lined with gastric mucosa. This mucosa was radiologically identical to normal oesophageal mucosa and the condition could not be directly diagnosed radiologically. The diagnosis, however, can be inferred, since the stricture marks the mucosal transition and the constriction, of the cardiac sphincter mechanism, the lower end of the gullet. In spite of the fact that the gastric mucosa at the level of the left main bronchus contained oxyntic cells, repair of the hernia with prevention of reflux from the stomach caused healing of the peptic oesophagitis and the disappearance of the stricture.

ILLUSTRATIONS

Case J. Sc.

Overleaf are the illustrations of the preceding case, consisting of radiographs of the barium examination with superimposed line drawings for the convenience of labelling and a coloured diagram correlating the radiographic, oesophagoscopic, operative and histological findings. The key to the coloured diagram is shown on page 23

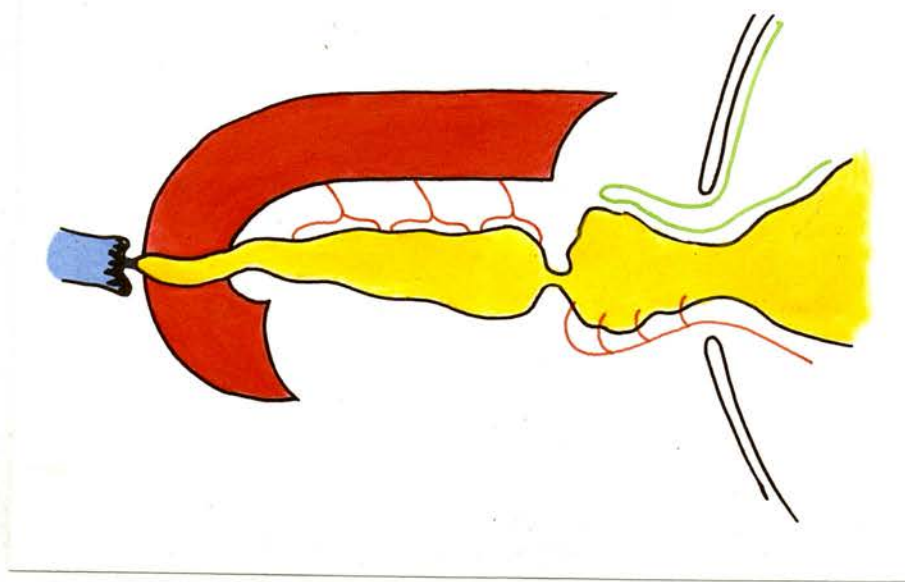


FIG. 74

FIG. 72

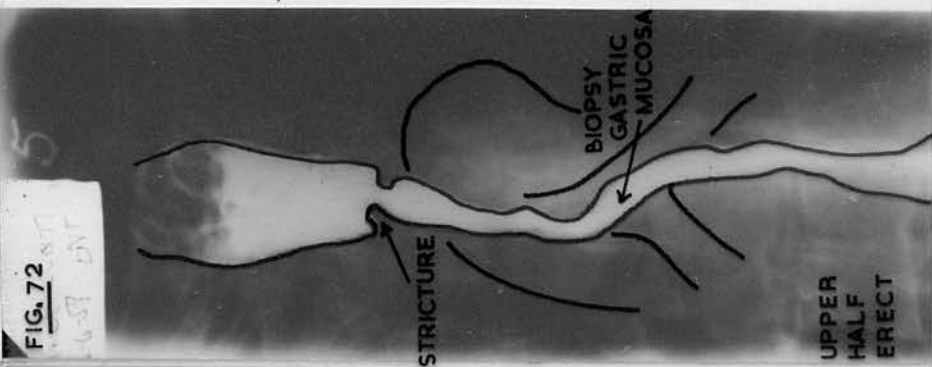


FIG. 73

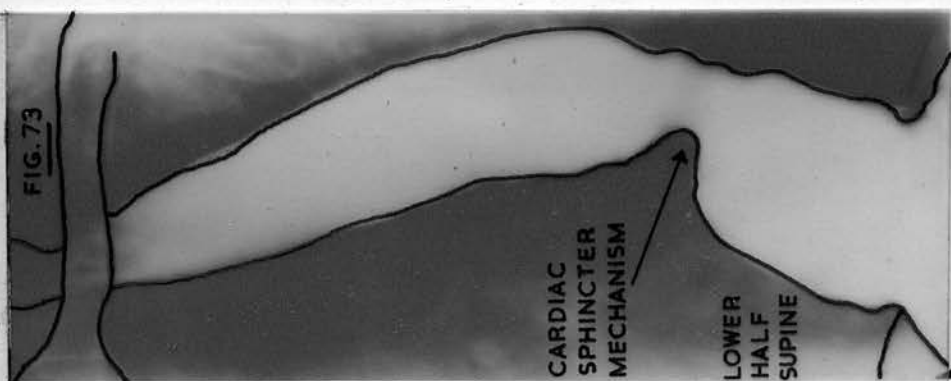
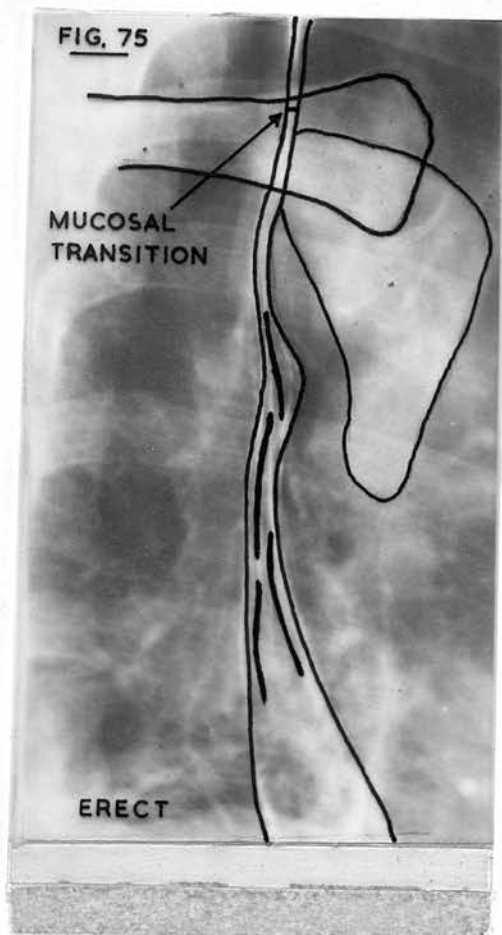




FIG. 75

MUCOSAL
TRANSITION

ERECT



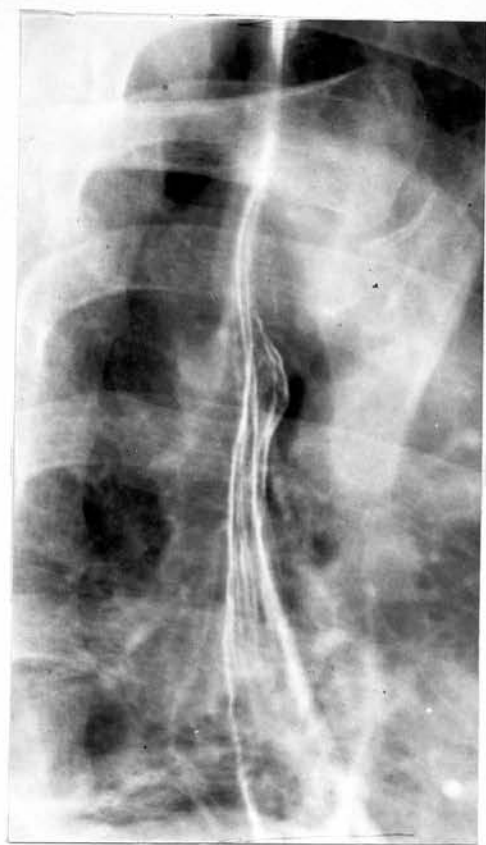
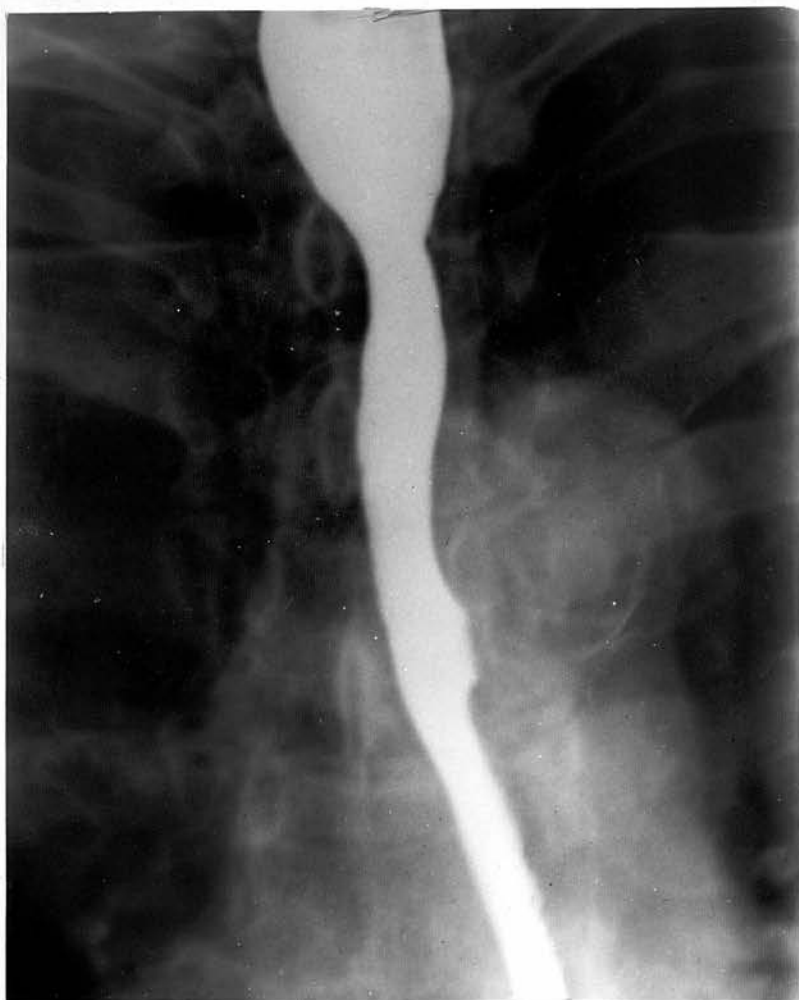


FIG. 76

POST-OPERATIVE
ERECT





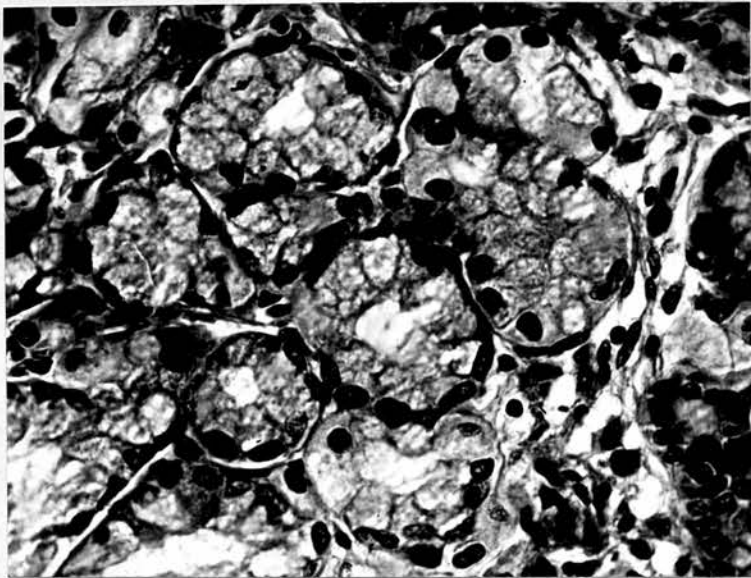


Fig.77

Biopsy at 27cm.(the level of the left main bronchus)
showing oxyntic cells stained by special method.
(Mark Drysdale)

CASE - B.R.

Female aged 60

FIRST ADMISSION 1959COMPLAINT

Dysphagia for one year.

HISTORY

This woman has never been ill and feels in good health except for dysphagia. This has been intermittent for twelve months but has been of considerable trouble over the last few weeks. When she does regurgitate it is most often caused by solid foods but occasionally by liquids. Her appetite is good and she has not lost weight.

PAST HISTORY

In the past she has been subject to indigestion and flatulence but she has not been worried by these in the last two years.

BARIUM MEAL Fig. 78

There was a short oesophagus type hiatus hernia with free gastro-oesophageal reflux. There was slight stricture formation at the level of the aortic arch. Between the stricture and the hernia there was a long segment of apparently normal gullet.

OESOPHAGOSCOPY

At 21 cms. from the upper alveolus there were typical changes of peptic oesophagitis ending in a stricture at 22 cms. The stricture was dilated and the gastric mucosa was apparent beyond it.

TREATMENT

Medical measures and dilatation.

SECOND ADMISSION 1961

Since discharge from her previous admission she was well until five weeks ago when she again developed dysphagia chiefly with solid foods. She has no pain and no heartburn.

BARIUM MEAL Fig. 79.

The appearances are the same as previously reported with the addition of another stricture in the middle of the segment of gullet known to be lined with gastric mucosa. In relation to this stricture there is a barium rest indicating a Barrett's ulcer.

OESOPHAGOSCOPY

At 21 cms. from the upper alveolus there was slight narrowing of the oesophagus but no peptic oesophagitis. The oesophagoscope was passed through the narrowing and immediately beyond gastric mucosa was seen. At 30 cms. the lumen ended in a stricture, the margins of which were overlapped by normal mucosa. Tissue was taken for histology from 24, 27, 30 cms.

BIOPSY

24, 27, 30 cms.

The three biopsies showed superficial gastric mucosa with mucous glands only. There were no oxyntic cells present.

COMMENT

It is apparent from the biopsy report and the endoscopic findings that the gullet below the stricture is gastric mucosa. This was not apparent radiologically as there was no gastric rugosity. The presence of gastric

mucosa lining the gullet can, however, be inferred from the fact that the stricture from reflux oesophagitis marks the mucosal transition and the lower end of the gullet is indicated by the constriction of the cardiac sphincter mechanism. Just prior to the second admission she developed a second stricture due, on this occasion, to a Barrett's ulcer. The intra-thoracic viscus is thus divided into four segments by:-

1. the stricture from reflux oesophagitis.
2. the stricture from Barrett's ulceration.
3. the constriction of the cardiac sphincter mechanism.

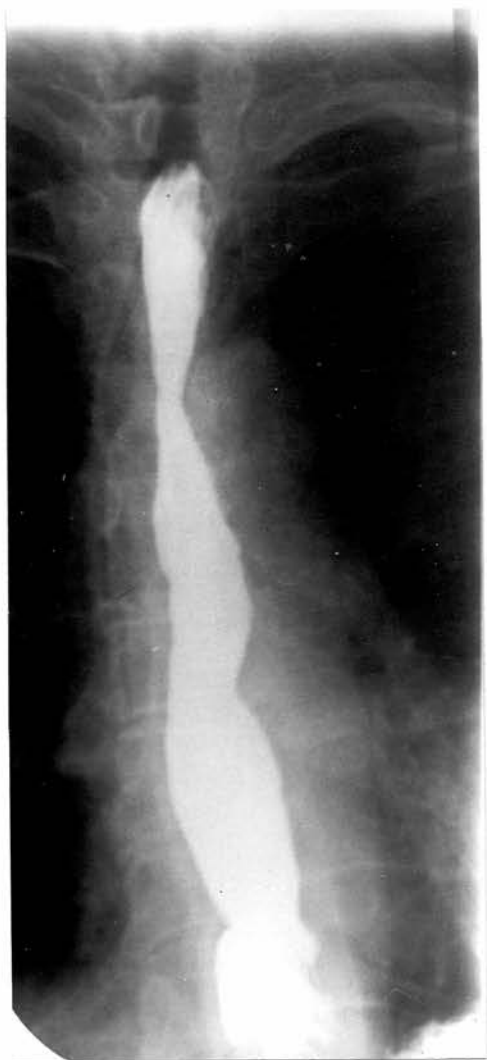


FIG. 78



FIG. 79

RADIOLOGICAL FEATURES

The radiological features of Types 1 and 2 were simply those of a "short" oesophagus type hiatus hernia and no features were detectable by which the two types could be distinguished. It is not proposed to discuss these further.

Types 3 and 4Table 3

<u>Case</u>	<u>Hernia</u>	<u>Peritoneal Sac</u>
M.E.	+	?
M. CU.	+	+
I. McF	+	+
D.G.	+	?
A.S.	XP	+
E.T.	O	O
E.K.	+	+
C.J.	+	+
J.K.	+	?
I.G.	O	O
E.D.	+	?
V.F.	O	O
A.P.	O	O
J.S.	+	+
A.W.	+	?
W.G.	O	O
M.CO.	+	+
M.D.	+	?
M.CL.	+	?
E.L.	+	?
A.Y.	+	?
J.SU.	+	?
C.M. (1)	XP	+
C.M. (2)	+	+
V.B.	+	?
W.T.	O	O
B.R.	+	?

P = Paraoesophageal

In 20 of the cases in which a diagnosis of gullet lined with gastric mucosa was made there was an accompanying hiatus hernia. Two of these were para-oesophageal and the rest were of the "short" oesophagus type. Six of these had clearly demonstrable peritoneal sacs, but there

was doubt in the case of the other 12 either because they had not been operated upon, or the surgeon had made no comment or because there was a possibility of the sac being self-reducing.

REFLUX

This was present in all the "short" oesophagus hernias and absent in the two para-oesophageal ones. In six of the cases there was no hernia but, rather surprisingly, in three of them reflux was present.

OESOPHAGITIS

Table 4

	Oesophagitis	Stricture
Reflux (23 Cases)	17	15
No reflux (5 Cases)	2	2

Oesophagitis was present in 19 of the cases presented and this was associated with stricture formation in 17 cases the stricture always occurring at the mucosal transition. In all but two of the cases with oesophagitis reflux was also present. The two cases with oesophagitis and no reflux are of great interest, the significance of this will be discussed later. Two cases had oesophagitis but no stricture and this oesophagitis was in no way apparent radiologically.

BARRETT'S ULCER

Table 5

Barrett's Ulcer	Hiatus Hernia	Reflux	Oesophagitis and Stricture at transition	Stricture from Barrett's Ulcer
1	+	+	0	0
2	+	+	0	0
3	+	+	0	0
4	+	+	0	0
5	0	0	0	+
6	0	+	+	0
7	+	+	+	+

Barrett's Ulcer was present in 7 of the cases. Hiatus Hernia and reflux were associated in 6 of the cases, but in one there was neither hernia or reflux. In 5 of the cases there was no oesophagitis at the transition and in only two cases were oesophagitis and Barrett's Ulcer combined. In 4 of the cases there was some narrowing associated with the Barrett's Ulcer but in only two cases did it amount to stricture formation. All ulcers demonstrated as an ulcer niche were in gastric mucosa lining gullet and in no case was the ulcer of oesophagitis of squamous mucosa so visible.

Barrett's Ulcers present a considerable radiological problem, not because they are difficult to see, but because they so closely resemble appearances associated with other pathology in the gullet. These are:-

- 1) A Diverticulum. Fig. 80
- 2) A pseudo-diverticulum associated with "corkscrew" gullet. Fig. 81
- 3) Barium trapped in the gastric folds of a hiatus hernia just above the hiatus. Fig. 82.

The distinction between a diverticulum and a Barrett's Ulcer may be radiologically impossible. An incisura



FIG. 80

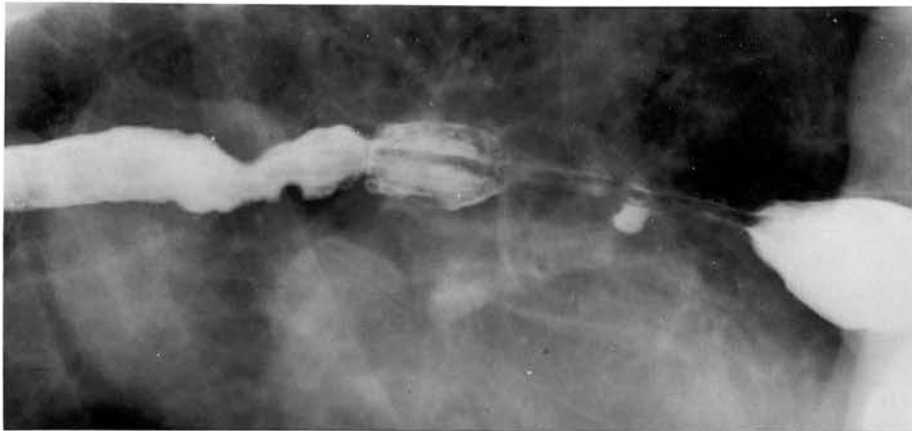


FIG. 81

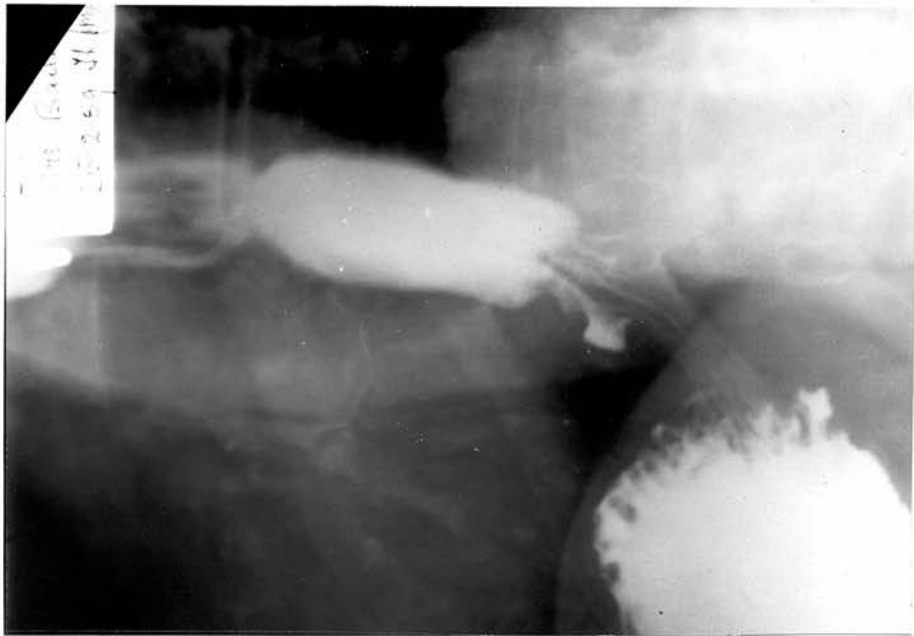


FIG. 82

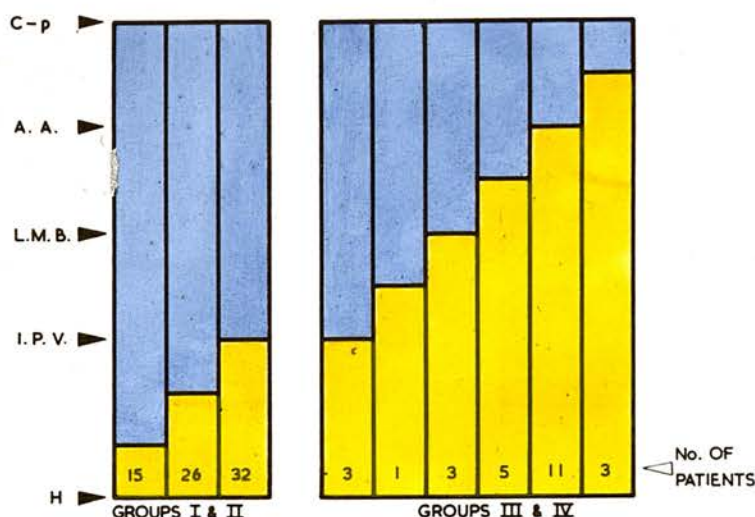
opposite the ulcer, stricture formation or radiating mucosal folds all may help in making a firm diagnosis. In the absence of these it is necessary to correlate the radiological findings with those made at endoscopy.

THE SEGMENT OF GULLET LINED WITH GASTRIC MUCOSA

This may look normally tubular and quite indistinguishable from normal gullet. The presence of a sphincter mechanism at its lower end is usually apparent as a short segment of intermittent narrowing most obvious when there is an associated hiatus hernia. The segment may show some dilatation in response to reflux but this too is intermittent and not present in the upright position. In many of the cases irregular spasm in the affected segment is obvious in response to reflux as is also the case when there is no lining of gastric mucosa. In 24 cases the mucosal pattern of this gullet lined with gastric mucosa showed the normal fine vertical lines, identical to those seen in normal gullet, and thus giving no indication of its presence. In 4 cases the mucosal pattern indicated heavier folds more in keeping with gastric mucosa and this was marked enough for the radiologist to comment on, at the time.

THE DIAGNOSIS

A comparison was made between the levels of the mucosal transition between Groups 1 and 2 and Groups 3 and 4 and the results are shown in the table below.



C-p = CRICO-PHARYNGEUS

L.M.B. = LEFT MAIN BRONCHUS

A.A. = AORTIC ARCH

I.P.V. = INFERIOR PULMONARY VEIN

H = HIATUS

■ = GASTRIC MUCOSA

■ = SQUAMOUS EPITHELIUM

TABLE 6

It is apparent that in all the cases in Groups 1 and 2 the mucosal transition was never higher than the level of the Inferior Pulmonary Vein while in Groups 3 and 4 only ³ ~~two~~ were at Inferior Pulmonary Vein level and the rest were all above it. This would indicate that if the mucosal transition and therefore the stricture from oesophagitis are above the level of the lower pulmonary vein then a portion of the gullet is lined with gastric mucosa.

The diagnostic features both direct and inferential are shown in the table below.

Table 7

Mucosal Pattern		Diagnosable by Inference			Not Diagnosable
Gastric Rugosity	Fine Vertical Lines	Stricture above Inferior Pulmonary Vein	Stricture above Int. Sphincter	Barrett's Ulcer in Apparent Gullet	No rugosity No Stricture No Barrett's Ulcer
4 cases	23 cases	15 cases	17 cases	7 cases	4 cases

In four of the cases the diagnosis of gullet lined with gastric mucosa was suggested by the mucosal pattern in the affected segment. Instead of the normal fine vertical lines seen in normal gullet on barium examination, the mucosa was to a variable degree rugose with heavy folds more in keeping with stomach than gullet. This feature in these cases was marked enough for the radiologist to note it at the time. In 23 cases on the other hand the mucosal pattern was entirely identical to normal gullet and the high transition was only apparent endoscopically. In these cases if the diagnosis is to be made at all it must be made by inference based on facts that the illustrated cases bring out. These are:-

- 1) That the stricture from oesophagitis marks the mucosal transition. The only exception to this being a stricture associated with a Barrett's Ulcer seen in two cases.
- 2) That if the stricture is above the lower pulmonary vein level then a segment of gullet is lined with gastric mucosa.
- 3) That all simple ulcers of the gullet visible as an ulcer niche on barium examination are in gastric mucosa lining that gullet.

In 15 cases the stricture from oesophagitis was above the level of the lower pulmonary vein.

In 16 cases it was possible to locate the internal sphincter at the lower end of the gullet as an area of intermittent narrowing more obvious and helpful in the presence of a hiatus hernia. Well above the sphincter the stricture was located with a portion of apparently normal gullet intervening. Eleven of the cases showed the characteristic three segments described by Johnstone, with normal gullet down to stricture and a "short" oesophagus type hiatus hernia above the hiatus and between the two a middle segment more like gullet than stomach. On these grounds it is possible to infer that this middle segment is lined with gastric mucosa.

In 7 of the cases there was an ulcer niche in the apparent gullet visible on barium examination. The fact that the section of gullet showing the ulcer niche is lined with gastric mucosa can be inferred from the fact that ulceration from oesophagitis of squamous mucosa is never manifest radiologically as an ulcer niche.

In 4 of the cases there was a high transition visible endoscopically, but there was no stricture and no Barrett's Ulcer present and the mucosal pattern was normal. In these cases the diagnosis could not even be suspected radiologically. Two of the cases which had no stricture had endoscopic oesophagitis but this was without radiological manifestations which is in line with our general experience that the only radiological manifestation of oesophagitis is stricture.

ADENOCARCINOMA

This complicated gullet lined with gastric mucosa in 2 of the cases in this series. In one, the gastric mucosa lining the gullet well above the level of the tumour extended up to the aortic arch and in the other it extended above the tumour to the level of the left main bronchus. In the first there was no radiological indication of the high transition although there was a "short" oesophagus hiatus hernia present. In this case the diagnosis could only be made endoscopically. In the second case although there was no hiatus hernia present the mucosa lining the gullet below the tumour showed the heavy folds of gastric mucosa which the radiologist noted at the time and in this case the diagnosis was indicated radiologically.

As has been said previously the endoscopic level of the tumour gives no strong indication of the diagnosis since it is well known that adenocarcinoma can grow up the gullet from the cardiac portion of the stomach as far as the aortic arch, even in the absence of hiatus hernia.

Two cases were selected from a group of 176 endoscopically visible adenocarcinomata as cases of gullet lined with gastric mucosa. It may be that a much larger number were in this category since all 176 cases were continuous with gastric mucosa inferiorly but it was impossible to establish the diagnosis in retrospect.

HISTOLOGICAL FEATURES

The histological features of the pre-fixed gastric mucosa have been assessed from the routine biopsy material obtained at endoscopy or from the microscopical examination of resected specimens. From these random samples it appeared that in 18 of the cases the gullet was lined with mucous secreting columnar epithelium forming simple tubular glands and deeper tubulo-racemose glands and identical to the epithelium lining the cardiac portion of the stomach. In 4 of the cases definite oxyntic cells were found in the pre-fixed gastric mucosa and this was confirmed by staining the sections by a special method. In one of the cases the actual level of the section was unknown though it was clear that it was taken from gullet. In another case the biopsy had been taken from 33 cms. (in the vicinity of the lower pulmonary vein) and in the remaining 2, the biopsy was from 27 cms. (at the level of the left main bronchus) and therefore high up in the segment of gullet lined with gastric mucosa quite near to the transition which in both cases lay at aortic arch level. It is quite clear that these oxyntic cells occurred in the upper half of the segment of gullet lined with gastric mucosa. This is contrary to Allison and Johnstone (1953) who said that oxyntic cells were entirely absent in the segment in question. Barrett (1958) stated that they may occur at the lower end. The two cases sited here indicate that they may also occur at the upper end. Deep oesophageal mucous glands were demonstrated under the pre-fixed gastric

mucosa in two of the cases and give further confirmation of the fact that the segment is gullet.

Islets of squamous mucosa appeared in the pre-fixed gastric mucosa in two of the cases but were so close to the transition that no particular stress can be laid on this observation. They were not specifically looked for by the pathologist at the time nor were widely distributed sections taken. There is, therefore no need to doubt the observations of both Allison and Barrett that they may appear at any level.

AETIOLOGY OF THE COMPLICATIONS

HIATUS HERNIA

The question arises as to why so many of these cases of gullet lined with gastric mucosa are associated with hiatus hernia? In the case of the paraoesophageal variety the only explanation is that it is an associated congenital anomaly.

The "short" oesophagus type presents a more difficult problem, the ones with sacs are probably acquired hernias which by the production of peptic oesophagitis have brought the presence of pre-fixed gastric mucosa to our notice. It is an important point that the condition is by itself symptomless and that it is usually the complicated cases that we see. The "short" oesophagus type hiatus hernias in which no peritoneal sac was demonstrated may represent true congenital short oesophagus as also the hernias in Group 2 of the general survey, and may be an additional congenital anomaly.

OESOPHAGITIS

This was present in 20 of the cases reported here and this could well have been due to reflux of gastric juice from the stomach in 18 of them as this was demonstrated radiologically in these cases. In the other two cases there was peptic oesophagitis with stricture but without radiologically demonstrable reflux to account for it. The absence of reflux in one case was confirmed on 2 separate occasions by 2 separate radiologists. This would indicate that the pre-fixed gastric mucosa can occasionally produce enough acid-pepsin to cause oesophagitis. The histological finding of oxyntic cells at a high level in the pre-fixed gastric mucosa is a further indication of this.

BARRETT'S ULCER

The cause of Barrett's Ulcer remains obscure as indeed does gastric ulcer generally. The close association between the concentrations of acid-pepsin and the degree of peptic oesophagitis of squamous mucosa is generally accepted. In 6 of the cases of Barrett's Ulceration there was free reflux into the oesophagus from the stomach and in only 2 of these was peptic oesophagitis of squamous mucosa present as well. Gastric Ulcers generally may occur in stomachs whose basal secretion and nocturnal secretion of acid do not exceed those of normal stomachs and indeed may produce a concentration of acid which is less than normal. (Ihre, 1938) There is considerable evidence to show that gastric ulcers occur in the absence of a "free acid" response to histamine. Levin, Kirsner,

Palmer, and Butler (1948) and Bockus (1943). There is therefore no clear association between gastric ulceration and the level of acidity and the same would seem to apply to Barrett's ulceration.

A possible cause might be the traumatic effect of undigested food on the abnormal ^{lining} of the gullet. Although squamous mucosa is susceptible to the digestive effects of gastric juice it is particularly suited to providing a smooth, tough, lubricated surface adapted to facilitate the passage of undigested food from pharynx to stomach. Gastric mucosa which is adapted to resist the digestive properties of acid-pepsin is not adapted to withstand trauma from undigested food. An interesting comment is made by Smith and Rivers (1953). "As the food enters the cardiac portion of the stomach it pushes the gastric wall apart, moving downwards along the lesser curve into the middle and lower portions of the organ. The path it traverses in the stomach is referred to as the "Magenstrasse" and significantly this is the pathway along which most gastric ulcers are produced". It may be that the segment of gullet lined with gastric mucosa suffers trauma from time to time and superficial erosions develop, such having been frequently reported by other observers. This erosion would provide an area of diminished resistance to gastric juice with the development of a chronic penetrating ulcer.

It has been suggested that islets of squamous mucosa in the pre-fixed gastric mucosa may represent areas

susceptible to acid-pepsin with the development of an ulcer. No evidence has been produced in favour of this view though it certainly represents a possibility.

AETIOLOGY OF THE CONDITION ITSELF

It is generally held that this condition is a congenital one due to failure of replacement of the columnar epithelium that lines the embryonic gullet.

Certain objections have been raised with regard to a congenital aetiology. Why, if this embryonic epithelium is replaced from the middle outwards, does this anomaly always occur at the lower end? No case of gastric mucosa lining the upper half of the gullet in a continuous sheet has ever been reported. Islets of gastric mucosa do occur and presumably these are due to the same failure of squamous replacement. The term ectopic or hetero-topic may not be the best term to apply to a condition which is simply a persistence of a foetal state.

Why is the pre-fixed gastric mucosa nearly always accompanied by reflux and why is a hiatus hernia of the short oesophagus type a frequent concomitant? Another explanation has been postulated on the analogy of cervical erosions. In these the squamous epithelium of the cervical canal becomes eroded and is then replaced by columnar epithelium growing down from the uterus to cover it. Similarly the desquamation of peptic oesophagitis may heal by an upward growth of gastric mucosa from the stomach which is more able to withstand the ravages of acid-pepsin. The possibility that the mucosa is regenerated from the deep

oesophageal mucous glands or superficial cardiac glands can be excluded since it would be clearly impossible to account for the presence of oxyntic cells in that case. The clearest confirmation of the upward extension theory would be the demonstration over a number of years of a climbing mucosal transition. This is described by Goldman and Beckman (1960). The case in question had radiological and endoscopic evidence of a mucosal transition climbing, during the course of nine years, from the junction of the middle and lower third of the oesophagus at 33 cms. to the level of the aortic arch or above at 22 cms. The radiographic evidence is so poor that it can be discarded. The crucial points of the case are endoscopic and histological. In 1950 a biopsy at 33 cms. showed both squamous and columnar epithelium and was considered to be the transition and in 1959 there was a stricture and oesophagitis at 22 cms. and a biopsy showed columnar epithelium, other biopsies at 24, 30, 52 cms. also showed columnar epithelium. The weakness of the case other than the unsatisfactory radiographic evidence is the fact that these observations were made by two separate observers at separate hospitals separated by a period of nine years. If one accepts these facts and ignores the possibility of an error of communication there is another explanation of these observations. The first endoscopist could well have failed to notice the transition at the aortic arch since gastric mucosa lining gullet may only be apparent by its colour other gastric mucosal features

being absent. Experience gained by reading the endoscopy reports of numerous observers shows that even moderately experienced endoscopists may pass the transition without being aware of it. The biopsy at 33 cms. may have been of an islet of squamous mucosa and the adjoining gastric mucosa. On the evidence of this single case alone the theory remains unproven.

Aetiological factors in the present series are shown in Table 8 overleaf.

Any information which might conceivably be relevant to the question of aetiology is tabulated below.

TABLE 8

Case	Age	Sex	Duration of Symptoms	Reflux	Height of Transition	Oesophagitis	Additional
M.E.	49	F	35 years	+	Aortic Arch	0	Rt. sided Aortic Arch
M.GU.	75	F	6 years	+	Carina	+	Hiatus Hernia
I.McF	57	F	2 years	+	Aortic Arch	+	Hiatus Hernia
D.G.	57	F	Six months	+	Aortic Arch	+	Hiatus Hernia and Uraemia
A.S.	64	F	Nil Relevant	0	Aortic Arch	0	Hiatus Hernia Paraesophageal and Hare Lip Cleft Palate
E.T.	16	F	14 years +	+	Aortic Arch -	+	Congenital Aortic Disease
D.T.	19	M	18 years	+	Left Main Bronchus	+	- - -
E.K.	52	F	4 years	+	Aortic Arch	+	Hiatus Hernia
C.J.	66	F	Six months	+	Aortic Arch +	+	Hiatus Hernia
J.K.	57	F	6 years	+	Aortic Arch	0	Hiatus Hernia
I.G.	57	F	2 years	0	Aortic Arch -	0	- - -
E.D.	58	F	2 years	+	Aortic Arch	0	Hiatus Hernia
V.F.	49	F	5 years	0	Inferior Pulmonary Vein	+	? scleroderma
A.P.	3	F	3 years	+	Carina	+	- - -
J.S.	60	F	20 years	+	Aortic Arch +	+	Hiatus Hernia
A.W.	67	M	8 years	+	Left Main Bronchus	0	- - -
W.G.	59	M	4 months	0	Left Main Bronchus	+	- - -
M.CO.	60	F	1 year	+	Inferior Pulmonary Vein	+	Hiatus Hernia
M.D.	50	F	1 year	+	Inferior Pulmonary Vein	+	Hiatus Hernia
M.CL.	43	F	9 months	+	Left Main Bronchus	0	Hiatus Hernia
E.L.	74	F	1 year	+	Carina	+	Hiatus Hernia
A.Y.	53	F	5 weeks	+	Left Main Bronchus	0	Hiatus Hernia
J.SU.	71	F	6 months	+	Aortic Arch	+	Hiatus Hernia
C.M.1	58	F	5 years	0	Aortic Arch	0	Hiatus Hernia Paraesophageal
C.M.2			1 year	+	Aortic Arch	+	Hiatus Hernia
V.B.	71	F	1 year	+	Aortic Arch	0	Adenocarcinoma
W.T.	57	M	20 years	+	Left Main Bronchus	+	Adenocarcinoma
B.R.	60	F	1 year	+	Aortic Arch	+	Hiatus Hernia

SEX

Twenty three of the cases were women and the other 4 men. Vincent Edmonds statistics gave 2.8 : 1 sliding and 10 : 1 paraoesophageal. From this series there is therefore an even higher female preponderance than for simple hiatus hernias.

AGE

This ranged from 3 years to 75 years. The vast majority of the cases being over 50 years.

DURATION OF SYMPTOMS

Some had very long histories the longest being 35 years. Three cases had a history extending almost from birth. If the cause of the condition was due to the upward replacement of oesophageal mucosa by gastric mucosa as a progressive healing of peptic oesophagitis then at least in cases with a transition as high as the aortic arch a long history would be inevitable the symptoms becoming less as the squamous mucosa retreated up the gullet. It was not possible in this series to detect such a symptom pattern. Five of the cases with high transitions had no symptoms referable to peptic oesophagitis whatsoever. Nine of the cases had a history of a year or less. One case with a transition above the aortic arch had a history of only 4 months and another of 6 months.

REFLUX

In 5 cases there was no evidence of reflux and therefore no obvious reason why the patient should ever have had oesophagitis. One case had no reflux and no

oesophagitis until her para-oesophageal hiatus hernia was transformed to a short oesophagus type hiatus hernia. One year after the operation she developed dysphagia and a stricture at the level of the aortic was discovered where the transition was located.

OESOPHAGITIS

Nine of the cases had no evidence of peptic oesophagitis whatsoever. They were detected because they had a para-oesophageal hernia or because they developed a Barrett's Ulcer. Four of the cases were detected, as it were, by chance. One in the investigation of anaemia not connected with her oesophagus, another a chance finding in the investigation of uraemia and another two because they developed adenocarcinoma in the pre-fixed gastric mucosa.

ASSOCIATED CONGENITAL ABNORMALITIES

One case had a right sided aortic arch another congenital aortic stenosis and a third hare lip and cleft palate. Two of the cases were associated with para-oesophageal hiatus hernias which are said to be of congenital origin.

FURTHER INVESTIGATION

A careful follow-up of all cases treated in the Thoracic Surgical Unit over a decade for reflux oesophagitis with particular reference to those treated by dilatation gives no clear cut evidence of a climbing transition though there is ample evidence of healing by regeneration of the squamous covering. Peters (1958) describes the regeneration of the squamous covering of a desquamated gullet from a

residual islet. It would seem likely that if gullet lined with gastric mucosa was the result of prolonged oesophagitis then there would be some evidence of fibrosis in the wall of the portion of the gullet lined with gastric mucosa. In none of the cases reported here is there any evidence of stricture formation below the transition except when there was clear cut evidence of an associated Barrett's Ulcer and there is no such case reported in the literature. One is led to the inescapable conclusion on the evidence presented that this is a congenital anomaly though this conclusion leaves certain associated features unexplained.

SUMMARY AND CONCLUSIONS

The causes of reflux oesophagitis have only been seriously studied during the last 20 years and it is not surprising that some aspects of this problem remain obscure. Allison (1948) showed clearly the association between hiatus hernia, reflux and oesophagitis. Barrett (1950) clearly differentiated the superficial erosion of the gullet described by the endoscopists and the deep penetrating ulcer of gullet described by the pathologists but concluded wrongly that it was in the wall of a hiatus hernia. This ulcer, nevertheless, is justifiably associated with his name. Allison and Johnstone (1953) clearly showed that cases occur where the lower oesophagus is lined with gastric mucosa and that Barrett's Ulcer occurs in this segment. The condition itself should properly be associated with Allison and Johnstone and it is ironical to note that the condition has already been referred to as "The Barrett

Syndrome" (Goodman and Beckman, 1960) when for over five years Barrett sturdily denied its existence, Barrett himself being the first to acknowledge this fact.

One hundred cases filed as hiatus hernia and operated on in the Thoracic Surgical Unit have been surveyed. Three clear cut groups could be defined, one a sliding hernia with a peritoneal sac another with no hernia but with a portion of the lower gullet lined with gastric mucosa and a third a combination of these two. There was a rather less well defined group with what appeared to be a short oesophagus type hiatus hernia on radiological examination but at operation it was not possible to demonstrate a peritoneal sac or to show evidence of peritoneal redundancy. Until this observation has been adequately explained it is not possible entirely to reject the diagnosis of congenital short oesophagus with partial thoracic stomach in these cases.

A special study has been made of cases with clear cut evidence of a segment of lower gullet lined with gastric mucosa and these are 27 in all including 14 from the general survey. All these cases were complicated and one is led to the conclusion that the condition per se is asymptomatic.

The gastric mucosa lining gullet is in the vast majority of the cases lacking the characteristic rugosity of normal gastric mucosa and this is confirmed both radiologically and endoscopically indeed in some of the cases one is tempted to think that it is actually smoother

than squamous epithelium. Four of the cases were exceptional in that the pre-fixed gastric mucosa did show normal gastric rugosity to a greater or less degree and the diagnosis was suggested on this account. In all the other cases the diagnosis had to be made by inference and the purpose of this thesis is to show how this may be done basing one's deductions on the height of the mucosal transition indicated by the radiological stricture and on the fact that the lower end of the gullet is frequently marked by the radiological manifestation of the cardiac sphincter mechanism when there is an additional hiatus hernia of stomach. Ulcer of the gullet manifest radiologically as an ulcer niche is always in gastric mucosa lining that gullet. In 4 cases in the absence of stricture or ulcer the diagnosis could not be made radiologically.

The reasons for calling this abnormal segment gullet have been discussed. Calling it gullet leaves only one thing to explain and that is how does it come to be lined with gastric mucosa? Alternatively calling it stomach leaves so many things unexplained that according to Allison it leads to an impasse in description.

The question of how this pre-fixed gastric mucosa has occurred has received consideration. The theory that there has been an extension of gastric mucosa up the gullet as a process of healing of reflux oesophagitis has had to be rejected on the evidence of the cases described and in the absence of any strong evidence in the literature of

a climbing transition. The conclusion is that this is a congenital anomaly due to failure of replacement of the columnar epithelium which lines the gullet in embryo and the presence of associated congenital abnormalities in some of the cases described helps to confirm this.

Finally Allison and Johnstone stated that oxyntic cells are absent from this pre-fixed gastric mucosa and Barrett says that they do occur but only at the lower end. In this series oxyntic cells have been demonstrated at the upper end as well. In the majority of the cases, however, the mucosa is entirely mucous secreting columnar epithelium devoid of oxyntic cells and the complicating peptic oesophagitis is thought to be due to reflux from the stomach although no method has been devised as yet for assessing the peptic potential of the gastric mucosa lining gullet. In 2 cases there was peptic oesophagitis but no reflux from stomach to account for it and it is presumed that it was caused by the secretions from the pre-fixed gastric mucosa alone.

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